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A Foundry Sketch—Low-Priced Work.

According to all the teaching and practice of the recognized authorities, elaborate, and in most cases costly tool making, must generally go before cheap production. Hundreds and perhaps thousands of dollars are put into tools for single operations on seemingly insignificant pieces; everything is gaged and finished to perfection, as nearly as the skill of man can achieve perfection. Every detail is made the subject of exhaustive consideration by high-priced experts, who have learned by long and varied experience everything pertaining to manufacturing operations.

The Chicago Skein and Axle Co., at Grand Crossing, a southern suburb of Chicago, makes cast-iron "thimble skeins" for wagon axles, which are shown in Fig. 1, from iron costing from .75 to .8 cents in the ladle, poured in four and five-part flasks, and machine these castings, making really excellent fits of the nuts and threads, with the nuts faced, and sell this principal branch of their output for 1.45 cents per pound. These figures leave at the best (taking iron in the ladle at .75 cents) .7 cents per pound to pay for elaborate molding in four and five-part flasks, machining, shipping and office outlay, and the general expense account. The manager said there was not much money in it.

The work turned out by the Chicago Skein and Axle Company is good. The irons used are high-class and high price of course, to make the stock cost 75 to 80 cents per 100 pounds in the ladle. The "Flint," "La Belle" and "Brown," as their leading styles of skeins are named, are very largely used, and have a high reputation in the market. The price is extremely low. The establishment has been in operation for many years. It follows, if the generally accepted ideas are correct, that the company should, or rather *must*, have a superlative establishment to make and sell their product and continue to exist. Their place would be supposed to certainly be "fixed up" to the highest mark of mechanical perfection.

Such is not the case. There are no brass-lined and bound mahogany patterns, no molding machines, no overhead ladle tracks, no metal flask parts fitted to interchange with perfect accuracy, in their foundry; there are no beautifully finished automatic tools in their machine shop. The foundry is good; one large floor, well lighted, with a high peaked roof; the flasks are rough wooden boxes; the rattle room has a lot of cheap old-style tumblers in it; the patterns are simply rough castings, absolutely without finish; the cores are all green sand, left by the patterns, which would certainly be expected to be finished inside so as to readily draw off from the long slender cores shown standing up in the lower section of the flask in front of the workman in Fig. 4; but the patterns are not finished inside, nor outside, nor anywhere else; they are simply rough castings, made of course in fine sand; the cores have a good taper, and if the sand hangs to the pattern in drawing, the molder applies a foundry file where it will do the most good—no sending the patterns to the metal pattern room for correction; there is no metal pattern room; everything in the foundry is of the lowest first cost possible. The molders themselves are a clean, bright, active lot of young fellows mostly, who attend strictly to business, and earn—when they do not lose too many castings—$2.25 to $2.50 per day—piecework, of course. They earn their money without a doubt.

The machine shop is a revelation indeed to eyes accustomed to what are supposed to be the best equipped work shops. The floor is composed, according to recollection, of parting sand; the atmosphere of the same, in a slightly less solid condition. The tools are of the rudest possible construction. There is no tool room; the small tools hang on boards at the back of the machines, or on spikes driven into the wooden frames of the machines themselves, and everything in the place is coated thick with parting sand—the dry, sharp sand that lies next to the skin of a gray iron casting in the flask, and has cutting properties about equal to emery. The light in the machine shop is good for a few feet next to an open door; nowhere else is there any light worth mentioning, as the windows are coated thick with foundry dust. In short, this machine shop is the last place in the world from which to expect good and cheap machine work, yet it does turn out a large amount of work which is not only extremely cheap but thoroughly good. A thimble skein consists of three pieces—a hollow, conical body with projection threaded up to a shoulder on its small solid outer end, a faced cast-iron nut to fit this finished thread, and a tapering cast-iron sleeve, to be fastened into the hub of the wheel and which is a fair, free, rough fit on the principal tapering surface of the skein. In Fig. 1, *A* shows a skein with its nut, and without its sleeve, or "box" as it is often called. *B* and *C*, Fig. 1, have the "boxes" in place, all complete, with the nuts on the "skeins." The term "skein" is doubtless a survival of the old blacksmithing days, when the wooden axle was carried on through the wheel hub, and reinforced on the top and bottom by an inlay of wrought-iron, bent in "skein" shape from a single bar, and threaded on the round end drawn out of the welded bend.

There is no finishing on the "box," and owing to its easy shape it can be readily molded in a two-part flask, or three-part flask, and have its own core of green sand. This is simply a fair ordinary job of gray iron founding, and there may be a good many gray iron shops which would be glad to make this piece alone for 2 cents per pound. A few would perhaps undertake it for 1¾ cents.

The Gates Iron Works make some rough castings as low as 1½ cents per pound, but they are heavy pieces and poured of any-thing that will run. In speaking of this job the Gates manager said the Gates shops would not care to supply gray iron work of any description whatever for less than a cent and a half. Mr. Craver, of Craver & Steel, who have a very excellently equipped foundry at Harvey, Ill., a few miles south of Grand Crossing, said his house would not make gray iron in any form for 1.45 cents, nor, he added, would he care to buy at that price; thus indicating 1.45 as about his idea of the long cost of simple gray iron castings. 1.75 is a not unusual price for heavy machine castings, involving considerable core work, and 2 cents and 2¼ cents is very often paid for plain gray iron castings of rather small weights; 2¼ cents being considered a very close price. There is a great gulf fixed between 2¼ cents per pound selling price for small gray iron work in plain forms, and 1.45 cents per pound for five-part flask work, machined.

It must not be assumed, however, from all this that the Chicago Skein and Axle Co. is losing money on its output; it must rather be assumed that work at that foundry is made at a lower price per pound than is common on gray iron floors. Hence all details of their practice are of decided interest. The reproductions of the foundry photographs tell the experienced foundryman more than any written description would tell. The floor is good and light; the flasks and patterns are of the cheapest kind; they are also of the lowest possible first cost, which is not thought in New England to be a mark of real cheapness in foundry equipment. The foundry equipment in manufacturing shops is often made as elaborate and costly as the machine shop special tools and fixtures are made; nothing is spared that thought can devise or money supply, because it is believed that all investments in tools tend to cheap production, and that the labor pay roll is the one cost factor to be attacked from every possible direction; practice on the lines of this theory has held trade in all lines for many years; on the other hand, the Chicago Skein and Axle Co. formulate an entirely opposite theorem, and say in words and in their practice, that the very cheapest production possible must include cheap, that is, small cost, plant, as well as small labor cost.

The three foundry interiors, Figs. 2, 3 and 4, tell clearly all the experienced foundryman wants to know about the molding of this cheap and good work. It may be of interest to note the exact details of the core support and final precise core placing which is followed in making this work.

The four tubes shown sticking up out of the sand in the flask in Fig. 3 are iron pipes, having rods driven into them which are long enough to reach the whole length of the core, and the tubes stand out a little below the bottom face of the sand on the bottom part of the four or five-part flasks; four-part in the views shown. The section of flask being rammed up in Fig. 3 is the second section from the bottom in the final close-up, as will be seen in the flasks closed at the left hand in Fig. 2; these wrought-iron tubes serve as handles by which the cores are finally adjusted after the flask is all closed up, so that the green sand cores stand exactly central; the bottom part of the flask stands on blocks which are high enough to let the workman pass his hand under the flask, and take hold of the pipes and tip the cores after the cope is closed on, so that the round top tit of the core stands exactly central in the holes shown in the top of the cope lifted off in Fig. 4; three of these adjusted cores are quite clearly shown, also in Fig. 4, in the closed flask at the left-hand lower corner. When the core is ad-

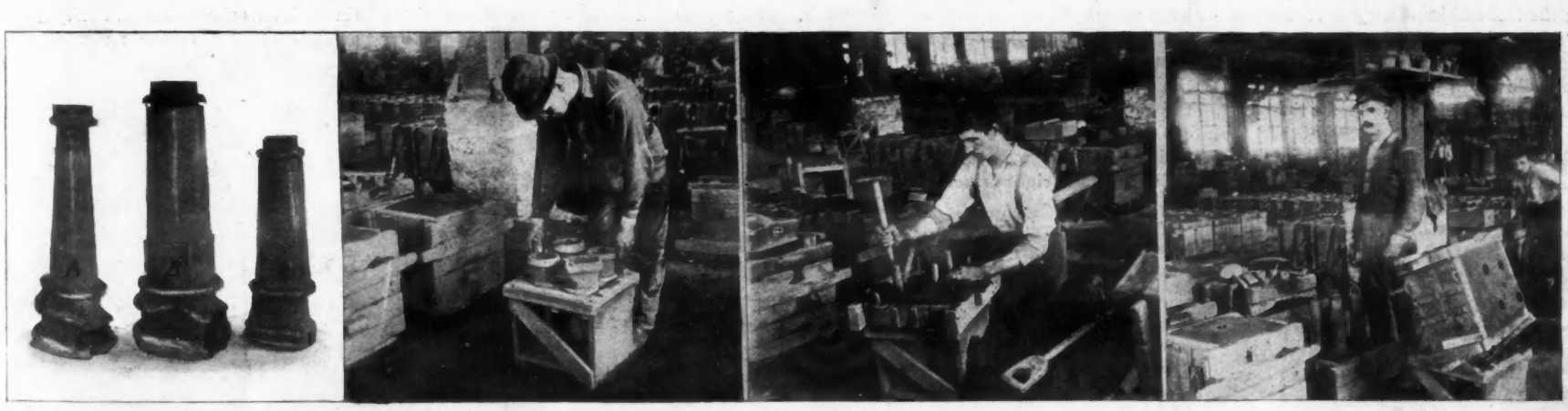


Fig. 1. *Fig. 2.* *Fig. 3.* *Fig. 4.*

LOW-COST FOUNDRY WORK.

justed the sand is tucked against the pipe on the bottom of the flask with the fingers, so as to hold the core exactly in place; the core-centering by this simple and seemingly inadequate method was perfect as judged by the eye, and showed that often surprising skill with which molders do their work.

From Figs. 2, 3 and 4 it is plainly evident that the foundry has absolutely no facilities or aids to cheap production beyond the simplest necessities of very common flasks, and very common patterns.

The equipment of the machine shop, of which views are given in Figs. 5, 6, 7, and 8, is of no higher grade than that of the foundry.

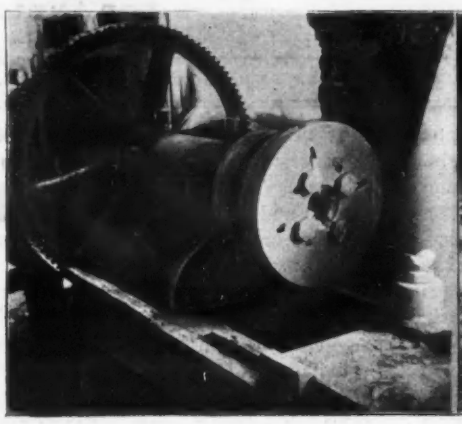


Fig. 5.

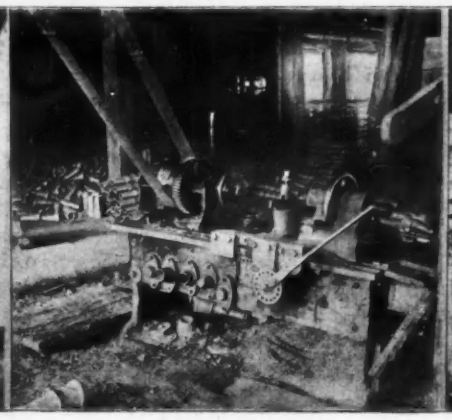


Fig. 6.

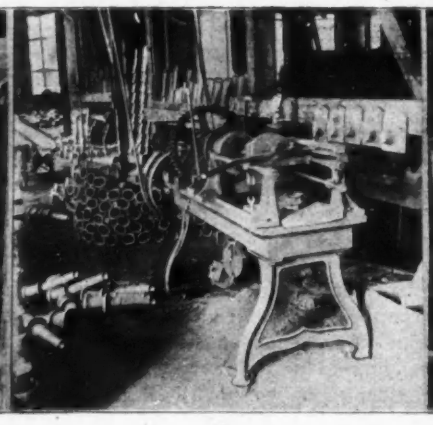


Fig. 7.

Fig. 8.

SOME SPECIAL TOOLS.

The irons used are "Ashland Silvery," mixed with "Iroquois" and "Bay View." These excellent brands of pig can, of course, be mixed to make extremely good castings, strong, and at the same time soft and free working, and it is, perhaps, owing largely to this use of high-grade stock that the tools here shown are able to do such a large amount of finishing. Whatever may be thought of the appearance of the tools, their output of finished work cannot be passed as low; the tool-making charges are undoubtedly extremely small.

Fig. 5 is a sufficient view of the four-tooth hollow mill which mills and squares up the out end of the skein for threading. The cutters are simply pieces of bar tool steel, cut to length, shaped at the cutting end on the emery wheel or grindstone, hardened whole length, dropped into the open seats in the cutter head, and confined fore and aft by the four large hex-head screws, without the formality of even so much as a washer between the screw head and the cutter body. They are held to their work by radial screws tapped into the cutter head, all as quite clearly shown in Fig. 5. These inserted tools are double-ended. A guess founded on the four unused tapped holes in the face of the cutter head would say that the original design embraced a now discarded face or cap ring to cover the front side of the cutters.

This head is strongly driven as shown, and with one operator mills 200 sets, or 800 skein ends of the largest size, or 250 sets, which is 1,000 skein ends of the smallest size made, in one day of 10 hours, including tool grinding and setting. The work is good, the milling for the shank to be threaded is kept very close to size, and the shoulder against which the faced nut screws up is a true, good job; the actual labor cost cannot be given; it is probably about ¼ cent for each skein end; for labor, including tool making, tool grinding and tool setting, which is not a large price.

Fig. 6 shows the skein-end threading machine, with a lot of skeins milled, ready for threading, on the dirty floor in front of the machine. The dies are loose pieces, of course, and are used in an open and shut head; the machine is all iron frame, and though of rather old design and light construction, is undoubtedly thoroughly adapted to its work. The average production of heavy and light cuts is 300 sets of skeins, or 1,200 pieces per day of 10 hours. The dies last a very long time, as cast-iron of the good quality used cuts very easily after the scale is out of the way.

Fig. 7 shows the wood-frame nut-facing lathe; this tool is a veritable antique, with iron sheers or "gantry" on top of a wood frame, a primitive tail stock, with threaded tail spindle, and hand-wheel nut between fore and aft shoulders in the middle of the foot stock. The saddle is of the simplest sort, with one single pinion working in a stationary rack, saddle gibbed in front only, and an adjustable position lever of ample length to squeeze the tool up to its work. Spikes driven into the wood frame serve to support some of the nut chucks not in use; those not so taken care of can be found in the chips and sand below. This rig faces 400 sets of nuts, or 1,600 pieces per day easily, and does good work. The nuts are drilled on an upright driller, which was not photographed.

Fig. 8 is a partial view of a long double bank of semi-automatic tapping spindles for tapping the axle nuts; once started the tap runs up clear through the nut, so it can be lifted out of the nut and driver; the artist (shown in the engraving) in charge of this bank of tapping spindles, then, at his convenience, picks out the tap, removes the tapped nut, lifts up the sliding nut holder, puts in another nut, and drops it on the point of the tap which he has replaced in the open, square socket in the end of the driving spindle below, and leaves it to its fate. This tool is not wiped up, except with a scoop shovel, and the scoop shovel is not used so long as there is room for the artist to walk around and reach the taps. Production—all that is needed; can tap from 1,600 to 2,000 or more nuts per day of 10 hours. The spindle drive is clearly enough shown, and is not noiseless.

After taking these photographs the superintendent piloted the photographer to the office, lighted a Wheeling stoga, sat down at his desk, and put his feet on the window sill, and spoke in words to this effect: "The trouble with you New England fellows is that you want so much stuff to do with that you eat up all there is in the job paying your tool makers. Out West here we have got no use for that kind of superintendents; we want a man who can get out work at low prices, and leave something for the proprietor. You may be all right on some work, but I do not know what it is; I have been around a good deal, and I never saw a job yet where the Western man would not beat the Eastern man out every time. You know too much about tool making, and not enough about making money; we do not care a pin for the tools, the work is what we are after; we get it, and we do it, and we are taking it away from the East, and we will keep on taking it away until you Eastern tool makers get a new crop of ideas."

The superintendent smoked, and was silent, and no one said anything in reply to his remarks.

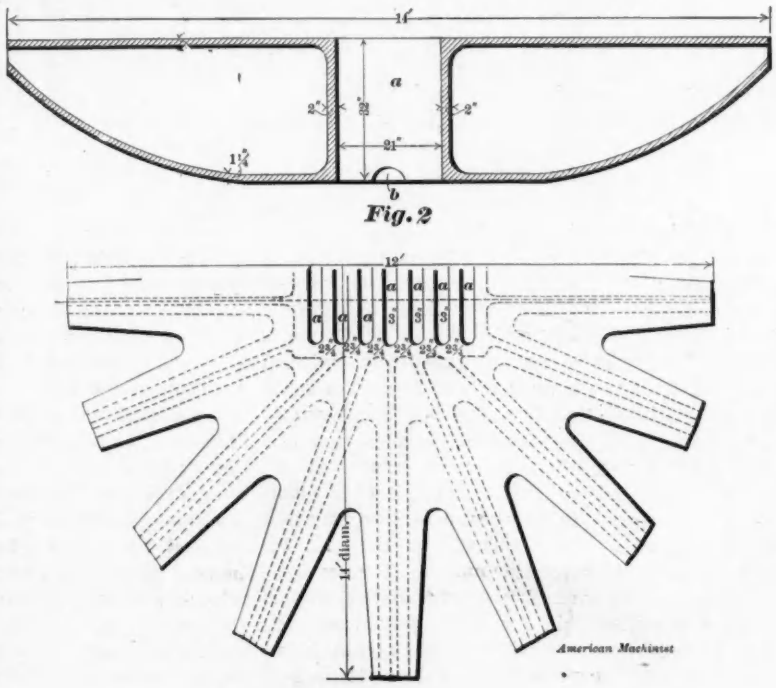


Fig. 2

Fig. 1

Some Good Steel Castings.

As an illustration of the great advance made by our founders in the art of making steel castings, I wish to give the following data:

In order to increase the capacity of the Covington and Cincinnati suspension bridge, built by the late John A. Roebling in 1865, and which was the longest span bridge in the world previous to the construction of the East River Bridge, it became necessary to add two additional cables larger than those heretofore found sufficient. The span of this bridge is 1,056 feet center to center of towers, and will be the same when enlarged, but the width of roadway will be nearly doubled.

These new cables are held in place by 3,800 cubic yards of masonry for each, at each end, and are connected to it by a set of anchor chains bedded therein. The first set of links or eye bars in this chain is vertical and secured to a cast-anchor plate on which the masonry is built. This set of anchor bars is composed of 7 bars, each 8x2¾ in. section and 20 feet long center to center of eyes; they pass through slots shown at *a a*, in Figs. 1 and 2, and are secured to the under side of the anchor plate by a 6-inch steel pin neatly fitting the bored semicircular seat *b*, Fig. 2.

Fig. 3.

GOOD STEEL CASTINGS.

The anchor plates are steel castings annealed, and are practically large 12-armed spiders 12 feet by 14 feet across the top, which is flat.

The arms of this spider are of I-shape as indicated in the drawings, and the metal varies from 1¼ to 2 inches in thickness, ex-

cept at the center, where, between the vertical bars, it is 2¾ inches thick. The castings are 32 inches deep and weigh 25,000 pounds each when finished.

The general upper surface of the arms from tip to tip, 14 feet long, does not vary in the finished pieces more than ½ inch from a true plane, not having been machined at all.

Steel founders will understand the difficulty of making such large and complicated pieces, but the Penn Steel Castings and Machine Co., of Chester, Pa., who made them with entire success, have had no particular difficulty. They left nothing undone, however, to insure success.

To show the superior quality of the metal, which was carefully tested, I give the following results of tests and also show four photo prints, Fig. 3, of the tension and bending test pieces. The test pieces were obtained by casting coupons attached to the upper or flat surface 14 inches long, 3 inches wide, and 1¼ inches thick, the same as the thickness of upper flanges of the twelve arms.

These coupons, six of which were cast at different arms on each casting, one nearest the gate and the other at the opposite end, were cut off, and one tension and one bending test piece were cut out of each.

The tension test pieces were turned to a standard shape for 8 inches gage length, while the bending strips were planed out about ½ inch thick adjoining the tension test piece.

The bending tests speak for themselves and are marvelous.

The results of tension tests from two separate castings were as follows:

Casting No. 1.	El. Limit.	Yld. Point.	Tenacity.	Elong. % in 8 in.	Reduction %.
Test No. 1.		32,500	62,050	24.1	51.0
Test No. 2.	22,430	33,240	63,900	24.3	50.0
Casting No. 3.					
Test No. 1.	23,090	35 540	70,620	18.75	31.0
Test No. 2.	30,780	34,630	70,620	20 25	27.0

The chemical composition of the two castings is as follows:

	C.	Si.	Mn.	S.	P.	Cu.
No. 1.....	.17	.254	.48	.033	.038	.00
No. 3..	.18	.286	.53	.035	.038	.00

The beautiful cup fracture of the first casting is something quite unusual and is precisely that obtained from rolled steel, but hardly expected in cast steel.

The cup was not so perfect in the piece from the third casting, but it was decidedly marked, and the fracture in both cases was almost identical with that found in rolled steel. The results, it will be noticed, would fill the requirements of nearly all bridge specifications for shape and bar steel, and had the third casting been slightly better annealed there can be little doubt that the results would have been almost identical in the two cases.

Not only are these results most wonderful and satisfactory, but the castings are entirely free from blow holes, pitting or honeycombing of any kind, and the edges are perfect at every part of the casting.

Not only is this perfection and freedom from pitting obtained in these large castings, but careful inspection of all the castings made during the last 45 days shows them to be almost equally good.

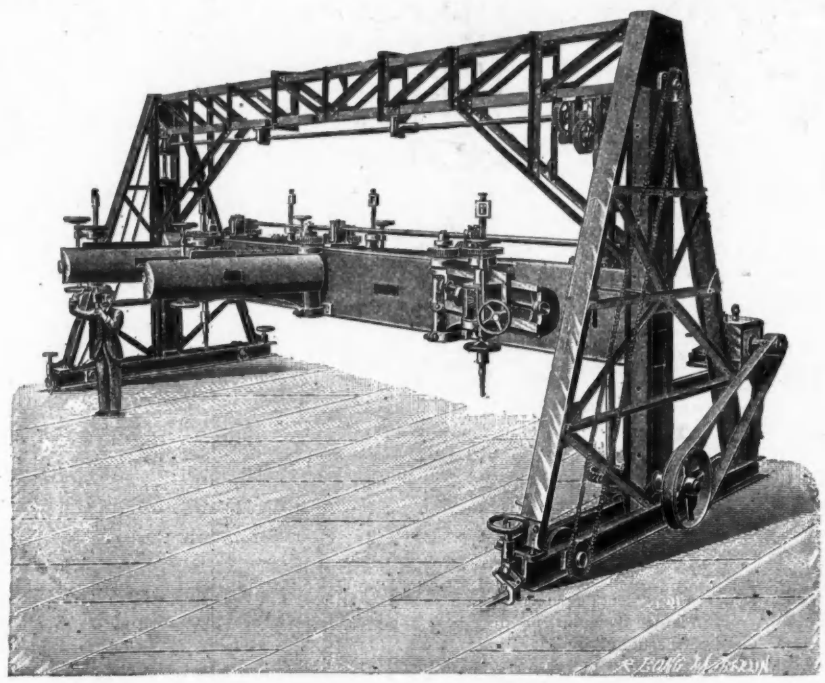
It seems that the Penn Steel Castings and Machine Co. have succeeded in doing what has long been attempted, the castings being even more uniform and reliable than iron ones usually are.

The remarkable point about steel castings is this, that whether cast thin or thick the quality of the material is practically identical throughout when annealed. The fracture when broken after nicking by chisel is very fine, bright, close-grained, and resembles rolled steel very much.

New York. GUS. C. HENNING.

Sextuple Electric Radial Drilling Machine.

We illustrate herewith a drilling machine lately built by Habersang & Zinzen, of Dusseldorf, for an establishment in South Germany. It is interesting for its size if for nothing else, and for the large area commanded by it. The frame of the machine is composed of two latticed uprights bound by a strong girder, and standing 10 meters (32 feet 9 inches) apart. A cross beam extending between the two uprights has a vertical travel of 2 meters (6 feet 6½ inches). This beam carries on each side of it three arms, each 2 meters (6 feet 6½ inches) long, similar to the arm of a radial drill, and carrying a form of the customary radial drilling mechanism. The total area covered by the machine is said to be $10 \times 4 = 40$ square meters (430 square feet), but this is evidently to be discounted somewhat, as there can be no drilling under the cross beam, and, as the several radial arms are not movable on the beam, the area covered by them is that of three semicircles on each side, more or less overlapping each other, instead of a rectangle of the dimensions given. The entire machine, however, is mounted upon rails, and is movable thereupon by its own power, so that the surface covered is determined only by the length of available rail. An eight horse-power electric motor is fixed upon the gear box attached to the cross beam. From this motor power is transmitted by suitable shafts and gearing to move the whole apparatus along the rails, to raise and lower the cross beam, or to operate each individual drill. The extremity of the base of each upright is provided with a clamp to secure it to the rails, so that when in use any pressure applied to the drills will not displace the machine.



SEXTUPLE DRILLING MACHINE.

Production of Aluminum.

The Geological survey will soon issue a review of the mineral resources of this country, and among other things treated, it will show that the production of aluminum has grown from 83 pounds in 1885 to 550,000 pounds in 1894.

The first step towards the production of aluminum for industrial purposes in this country, was taken in 1885 by the Cowles Electric Smelting and Aluminum Company, of Cleveland, Ohio, which began to make aluminum bronze in that year. The Cowles process attracted much attention, as it was the beginning of the dynamo-electro metallurgy in the United States. This commercial product was aluminum alloys and not metallic aluminum.

This process consisted in reducing alumina in the presence of charcoal and granulated copper by a current from a powerful dynamo electric machine. An oblong receptacle or furnace of fire brick lined with carbon and provided with a suitable cover was employed, through the ends of which the large electrodes of the dynamo were fitted. The mixture of alumina, charcoal and granulated copper was introduced into this receptacle between the electrodes, and the current was turned on. Under these conditions the aluminum was reduced to a melted mass which formed an alloy with the copper, which was melted by the heat produced in the furnace, and this alloy being rich in aluminum, was afterwards remelted and enough copper added to make the bronze of the desired percentage of aluminum, 5 or 10 per cent., as the case might be.

The Cowles Company made between 4,000 and 5,000 pounds of this bronze in 1885, which was sold at 40 cents a pound. Much was expected from this bronze, and the list of uses proposed for it covered a wide range, from ordnance to small fancy articles. Its tensile strength was found to vary with the varying amounts of aluminum, from 53,000 to 72,000 pounds per square inch. Besides aluminum bronze, the Cowles Company also made aluminum brass, that is, copper zinc alloy containing aluminum.

This alloy became of considerable metallurgic value in the next few years because it was used as a vehicle for introducing small quantities of aluminum into molten iron and steel. This use of aluminum was a recent discovery, in 1885.

A Swedish metallurgist, Mr. Peter Ostberg, announced in a paper read before a meeting of the American Institute of Mining Engineers, that if a very small proportion of aluminum introduced in the form of an alloy is added to melted wrought-iron just before casting, the mold retains its fluidity so as to be worked without difficulty.

The demonstration of this fact was speedily followed by the formation of a company to use the process and "Mitis" castings became known to the trade. In 1886, the Cowles Company produced 50,000 pounds of aluminum bronze as against 4,000 to 5,000 pounds the year previous. The tensile strength of wrought-iron treated with aluminum was said to be increased, so with this feature together with the facility of casting, it was expected would give to the furnace a power to produce iron equal to mild Siemens-Martin steel. The addition of one per cent. of aluminum to steel was found to effectually prevent the formation of blow holes. The tensile strength of the steel was considerably increased.

Up to this time aluminum for commercial purposes in the United States had not been produced, but in 1888 the Hall process of obtaining aluminum by electro-metallurgy was put into operation by the Pittsburg Reduction Company, of Pittsburg, Pa.

Up to May, 1889, the production of aluminum by this process was 3,500 pounds, which sold at $5 per pound for ingots and from $7 to $9 in sheets, in 1888, but early in 1889 the price fell to $2 for ingots and $5 for 50-pound lots.

In order to introduce the new method to favorable notice in the trade, cooking utensils, forks, spoons, etc., as well as clocks, watches, clock cases and fancy articles usually made of German silver, were made of aluminum, as had been done in Europe. The production of aluminum in 1889 was 19,600 pounds, and in 1890 it was 47,880 pounds, and the price fell below $2.

The discovery of large and workable deposits of bauxite in Georgia and Alabama, which began to be worked in 1891, showed that abundant "ore" of aluminum exists in this country. In that year the production of aluminum was greatly increased, both here and in Europe, and amounted in this country to 100,000 pounds, including that contained in alloys. In 1892, the production of aluminum in this country amounted to 259,885 pounds, and in 1893 to 533,629 pounds, including alloys, the greater part of which was metallic aluminum.

The aluminum industry in the United States has become of considerable and growing importance, and the manufacture has grown from nothing until the value of the output amounts to over $200,000 per year, while the price has fallen to one-tenth what it was in 1888.

This metal has found the position in the arts which might have been predicted for it from its properties, and the demand is increasing.

Its metallurgical use has proved as favorable as it was unexpected, and it is likely that the metal will find a wider employment in that direction and as a constituent of alloys.

In 1889 metallic aluminum came into use in treating molten iron and steel in the same way that ferro-magnesia had been employed previously, and a large part of the production of the Pittsburg Company was consumed in this way. It had been found that cast-iron and steel were benefited by the addition of a small quantity of aluminum, and numerous experiments were made to explain the action, and ascertain the exact character of the improvements in iron which were attributed to this treatment. The tests made by Mr. W. J. Keep are especially worthy of mention. He found that the increased solidity of the casting was due to the separating of the graphitic carbon which filled the space between the particles of iron. He explained this fact by supposing that at the time of the solidifying, the chemical combining, carbon assumed the graphitic form in consequence of the aluminum which was present, but the precise action of the aluminum was not understood.

Experiments were made in England to discover the cause of the changes produced in iron and steel by the small quantity of aluminum (1 per cent.) added to the mold before casting. These experiments were described by Mr. R. A. Hadfield in a paper read before a meeting of the Iron and Steel Association, showing that the prevention of blow holes in castings and dispossessions of graphitic carbon may be due to the reducing action of the aluminum, direct experiments having proved that the mold will decompose carbon oxide at a very high temperature, taking up its oxygen and setting its carbon free. This would prevent the escape of gas in molten iron or steel, and so prevent blow holes. Mr. Hadfield likened the action of aluminum to that of silicon at a high temperature.

An aluminum torpedo boat was built in 1893 by Yarrow & Co., for the French Government. She was 60 feet long and 9 feet 3 inches in width. Her weight, with machinery on board, and boilers full of water, was 9½ tons, and she made 20.5 knots. There were also a 10-ton yacht, and a 33-foot sailing boat built in France of aluminum, and aluminum boats for the Wellman Arctic Expedition were made in Baltimore. This metal is destined to play an important part in commerce.

It has been claimed that aluminum would be available as a valuable material in the construction of naval vessels. This claim was urged so strongly and brought so persistently before the officers of the navy, that they decided to make tests of the metal. Specimens of aluminum were submitted to tests in salt water, and the naval officers who have examined these specimens say that the metal will not be available for use in the construction of naval vessels, because after

being in salt water for any length of time it crumbles to pieces. It cannot withstand the action of salt water, and it is believed that only one metal known to science will thoroughly do this, and that is copper.

In a recent interview, Mr. McGuire, the New York representative of the Pittsburg Reduction Company, stated that the aluminum tested by the naval officers was alloyed with zinc, which accounted for its deterioration under salt water. He said that if alloyed with nickel, salt water seemed to have no effect upon it.

"The Mechanical and Electrical Regulation of Steam Engines"—I.*

BY JOHN RICHARDSON, M. INST. C. E.

The great speed and delicacy of many of the machines used in the textile and similar industries, and the requirements of engines for the generation of electricity, have called forth many new methods of governing. A good governor should be reliable, simple in construction, easy to drive, and instantaneous in its action, both in increasing as well as in reducing the supply of steam. It should not reduce the power of the engine to which it is applied, but should tend to economize steam; and, while allowing for great variations in the power of the engine, it should maintain a practically uniform speed.

Mechanical Regulation.—The form of governor in almost universal use until a few years ago was that invented by Watt, Fig. 1. It was connected generally through several levers and rods with the wing throttle valve, Fig. 2. This governor can prevent an engine from racing when the load is removed, and may regulate it within certain limits, but it cannot secure uniformity of speed under greatly varying loads. The speed of revolution at which the balls can be maintained when in the position 2 in the figure, is widely different from that required when they are in the position 1, and no possible increase of speed could raise them beyond the position 3.

The Porter governor, Fig. 3, is a marked improvement upon the Watt governor. A heavy central weight *A* offers a constant resistance to the lift of the balls, which are caused to revolve at a much higher speed than would be required without the central weight. This governor gives a much wider range of travel with a smaller difference of speed than the Watt governor.

A form of governor possessing some further advantages, which was designed by the author about twenty years ago, is shown in Fig. 4. In this governor, the arms, instead of being suspended from a single fixed point, are suspended from two points and cross each other. The effective length of the arm being that between the center of the ball and the point *A*, where the arms intersect, increases as the balls rise, the increase of length being shown by the difference between *B* and *C*. The balls are kept close together at their lowest position, and thus as they diverge the effective length of arm increases more rapidly than the rise of the balls. It is quite easy to proportion governors of this class so that the sleeve will have a large range of motion with very small difference in speed. This advantage is obtained only at a sacrifice of power, and when rendered isochronous such a governor is practically useless for controlling any valve or gear which requires much power to move it, as, at a fixed speed, the weighted ball will stand indifferently at any point between its lowest and highest positions. To be of the greatest use a governor must have great lifting power, forcing power and stability at every point of its range, and a large motion of the sleeve in proportion to the difference in speed of revolution. The ordinary pendulum governor is stable, but unless it is of great size in relation to the engine, it has but little lifting and forcing power, and the best governor cannot, when the greatest fluctuations in the load of the engine occur, prevent the velocity from varying by at least 10 per cent., but much better results may be obtained by the combination of such a governor with a spring.

In such a combination an entirely new set of conditions is presented. Gravity may now be practically disregarded, for a much stronger force is substituted for it. Such a governor can therefore act equally well in any position. One of the earliest examples of this kind of governor is that designed by the author in 1869, shown in Fig. 5. In addition to the spring another feature is introduced, viz., the lengths of the arms are so proportioned that the balls diverge in nearly a straight line for a considerable distance. The centrifugal force generated by revolution at a given speed at a radius of 4 inches is manifestly much less than that generated at the same speed with a radius of 8 inches, and this large difference is counteracted by the increasing force of the spring as it is compressed. Such a governor may be made to give a travel of the sleeve of, say, 3 inches, for a change of velocity of only 4 per cent., and it has a lifting and forcing power of 100 pounds; that is to say, when revolving at a speed corresponding to its lowest position, it would require an upward pressure of 100 pounds on the sleeve to raise it to its highest position. The force required to move it through the same distance when not revolving is 200 pounds. A variety of this type of governor, introduced by Proell about the year 1884, is illustrated in Fig. 6. In it a heavy central weight is substituted for the spring, though the action of the arms is similar. Instead of the increased force of a spring a weight is lifted at an accelerated speed as the balls diverge. This governor is extremely sensitive, but has practically no lifting or forcing power, and needs a dash pot to give it stability. Something in the nature of a dash pot is introduced in the governor and is shown in the section, Fig. 7, but as this contains air only it is almost ineffective. A perfect governor should not need a dash pot, but if one be used it should contain some incompressible substance which can escape only through a small aperture from one side of a piston to the other, as shown in Fig. 8.

Until comparatively recently governors for controlling the speed were almost universally applied to engines by means of the wing throttle valve, Fig. 2. This valve, though simple in construction and easy to move, is difficult to fit so as to remain steam-tight. One of the first requisites of a regulating valve is that it shall be able to entirely stop the admission of steam, and this becomes more important as the steam pressure becomes higher. The valve shown in Fig. 9 is a considerable improvement upon the butterfly valve. It is easier to make and easier to work; and for regulating variations in load with a good governor it acts well. It is, however, more difficult to obtain a perfect fit with it than with a piston valve, so that the valve will move without friction, but still be sufficiently tight to shut off all steam. Careful experiments made with free-running engines show at least 15 per cent. of variation between all load on and all off, the small space required to pass sufficient steam to drive an unloaded engine being almost incredible. The equilibrium double-beat valve, Fig. 10, has been found by the author to give the best results of any kind of throttle valve. The arrangement shown in the figure is that of a valve not quite in equilibrium when closed—the area of the upper part being so much greater than that of the lower, which is equal to the area of the stalk, that the valve has a constant small upward pressure, whether on or off its seat, which makes it move ready to respond quickly to minute changes of the governer, there being no slack or backlash. Combined with a well-proportioned high-speed spring governor, it will, with changes of load not exceeding 75 per cent. from the maximum, maintain a speed within 5 per cent. of the normal; but the difference between maximum load and no load is nearly 10 per cent. with a steam pressure of 100 pounds per square inch, the difference being much less with a lower pressure of steam. Another form of valve which is largely used in England and America is shown in Fig. 11. It works nearly in equilibrium, the stalks being small, and the two disks being of the same diameter. Combined with its own governor, it will maintain a nearly constant speed with moderate changes of load, but it fails to cut off the whole of the steam, and thus with light loads, or no load, the variation of speed is very considerable. Careful experiments upon it showed a variation of speed of 14 per cent., and it was found impossible to reduce the difference below this amount, when the comparison was made between the greatest load the engine could carry at a definite speed, and no load. All throttle valves, though simple and easy to manage, have necessarily the objection that they regulate the speed by altering the pressure of steam in the steam chest and cylinder; and thus cannot fulfill two of the essential conditions of a good governor, namely, that it should not diminish the power of an engine, and that it should increase rather than diminish the economy of steam. For many purposes, however, where great delicacy of governing is not needed, such a valve as that shown in Fig. 10 is all that is required.

The next important type of governor is one which controls a slide valve, and which regulates the speed either by regulating the travel and angle of the main valve, or by limiting the admission of steam through controlling the angular advance and travel of a cut-off slide working on the back of the main valve. Governors of the former type

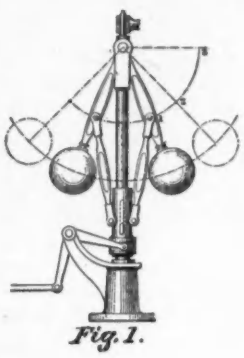


Fig. 1.

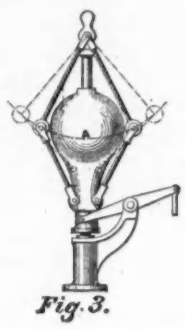


Fig. 3.

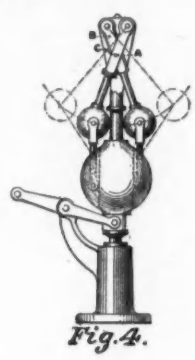
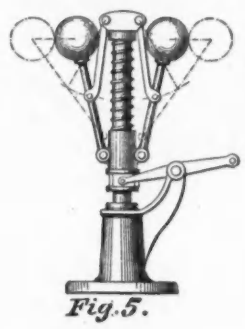


Fig. 4.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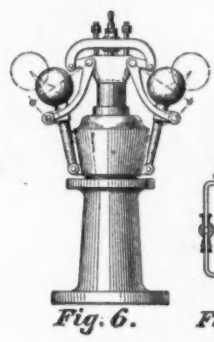


Fig. 6.

Fig. 8.

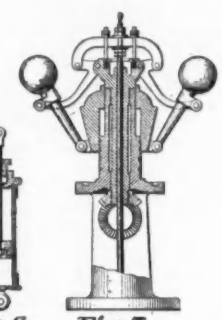


Fig. 7.

Fig. 10.

Fig. 11.

Fig. 2.

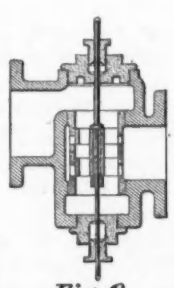
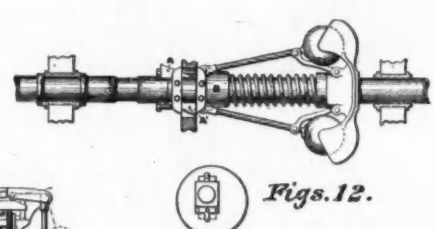


Fig. 9.


Figs. 12.

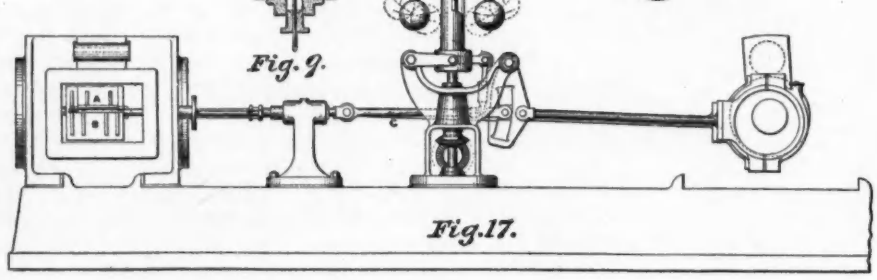
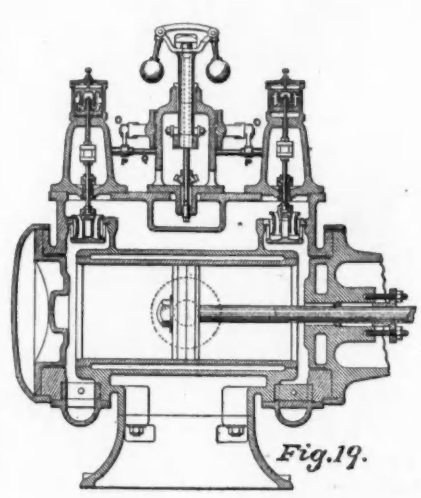


Fig. 17.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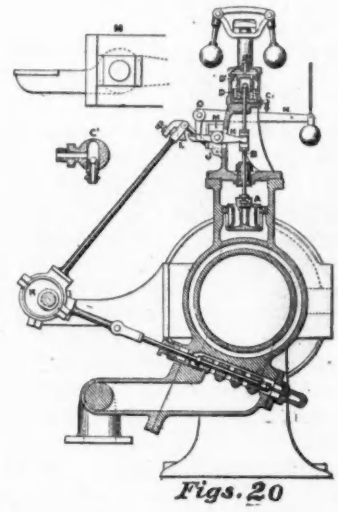

Figs. 20

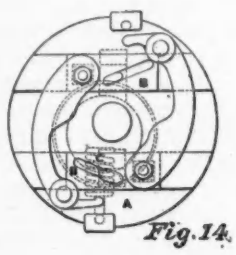


Fig. 14.

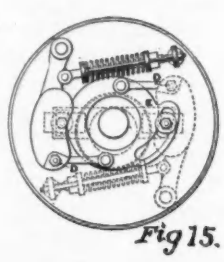


Fig 15.

* From "Proceedings of the Institution of Civil Engineers." Condensed by and for the AMERICAN MACHINIST.

generally revolve with the crank shaft, and are known as shaft governors—one of the first of these to be used being that made by the author in 1869, shown in Fig. 12. In this case a governor of the spring type, Fig. 5, is used in connection with an adjustable eccentric. The object to be attained is to move the center of the eccentric in a straight line at right angles to the crank, thus maintaining a constant lead while varying the travel, and the point of cut-off. This is accomplished by a pair of wedges *A A* moving in the same direction and connected to the moving slide *B*. Fig. 13 is a copy of the first diagram taken from an agricultural 8 horse-power portable engine, fitted with this type of governing gear. It will be observed that, unlike some other adjustable eccentrics in which the eccentric floats on the arm of the governor, in this case the eccentric is driven by the square part of the shaft, and, while the wedges adjust its position with regard to cut-off, yet at the same time they hold it firmly at all points. This is an important advantage, and permits its application to an ordinary simple flat slide valve; while governors which depend upon the stability of position in the balls or weights, need an equilibrium slide valve because they are not sufficiently stable to work with a flat side.

A modification of this gear, occupying much less space but working on exactly the same principle, is shown in Fig. 14. The eccentric is guided and driven from the slots in the plate *A*, and is caused to travel at right angles to the crank by means of the wedges *B B*, which are again moved by the arms of the governor, the centrifugal force of the balls being counterbalanced by the spiral springs *C C*. The wedges *B B* are each double, that is to say, a wedge above and one below, this being necessary as the shaft has to be both pulled and pushed. When connected at their ends, the two wedges become a plate with an inclined slot in it. A much simplified modification of this arrangement is illustrated in Fig. 15. In this the two flat plates working in planed grooves are replaced by a disk *E*, partially revolving on the boss of the casing. An inclined slot is cut in this disk, and the incline is bent to a radius equal to its distance from the center. A projection from the eccentric slides in this slot, and is moved at right angles to the crank as before. This partial revolution of the disk is given by the weighted arms of the governor, as in the case of the straight wedges, but in this case through the links *D D*. The whole of the driving is done by the disk, the eccentric is held rigidly in position by the slots and wedges which are at right angles to each other, and there are nevertheless four points in each revolution when it is quite free to be moved and adjusted by the governor arms. With a properly proportioned governor of this type, there is no difficulty in maintaining a practically constant speed with ordinary changes of load, and between maximum load and no load, the variation of speed can be reduced to 3 per cent. With this method of governing there is, of course, no wire drawing of the steam, and thus no reduction in the power of the engine; and further, the full boiler pressure being always attainable, the steam can be cut off early, and the maximum economy obtained from it.

The American pattern of throttle-valve governor reduces the power at all pressures much more than shaft governor, the latter allowing the engine to develop on an average about one-sixth more power with the same pressure of steam. With the shaft governor, the variation in speed is between 2¾ per cent. and 3½ per cent., and with the throttle valve 10 per cent. and 15 per cent. With the more delicate governor, the fluctuation, though less in quantity, is naturally greater when measured by time, in one case amounting to 75 seconds. In this case, however, the extreme variation for the first second was only 8.7 per cent. and gradually fell to zero. With the less sensitive governor rest was arrived at in 25 seconds, but the variation was more than twice as great, viz., 16.8 per cent. Another important difference is remarkable, viz., that with the shaft governor the variation is nearly all upward; thus, if the normal speed is 352 revolutions per minute, when the load is suddenly applied the decrease of speed is only two revolutions per minute, and the variation causes an instantaneous upward rise gradually coming to rest with decreasing oscillations. On the other hand, with the throttle valve the sudden change is downwards, gradually rising with few oscillations from 310 to 350. It should be noted that the changes in load were made suddenly, all being put on and taken off at one time. With gradual changes there is practically no fluctuation either with the shaft or throttle-valve governor. Table I. shows the slight variation in speed of an engine fitted with this governor driving an electric light installation, from which it will be seen that the total variation in speed is slightly under 3 per cent. from no load to full load, and that with variations of over 50 per cent., or from 280 to 380 amperes, the variation in speed is only one revolution per minute, or less than ½ per cent. The power of this governor, to prevent any of its parts from being moved out of their proper positions, is very considerable, the springs requiring a force of 1,100 pounds to move them from the extreme inward to the extreme outward position.

TABLE I.—SHOWING UNIFORMITY OF SPEED OF AN ENGINE FITTED WITH A SHAFT GOVERNOR.

Revolutions Per Minute.	Amperes.	Revolutions Per Minute.	Amperes.
214	0	208	380
213	50	209	280
213	65	211	180
210	80	213	80
209	180	214	0
209	280		

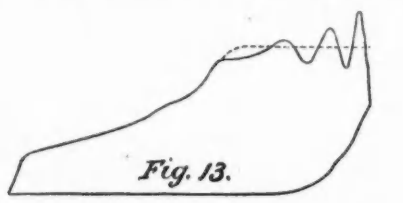


Fig. 13.

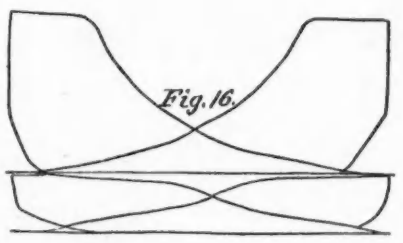


Fig. 16.

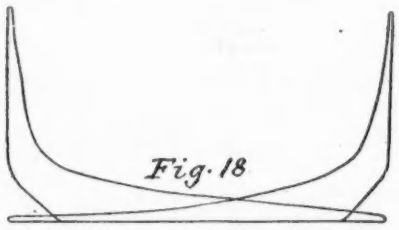


Fig. 18

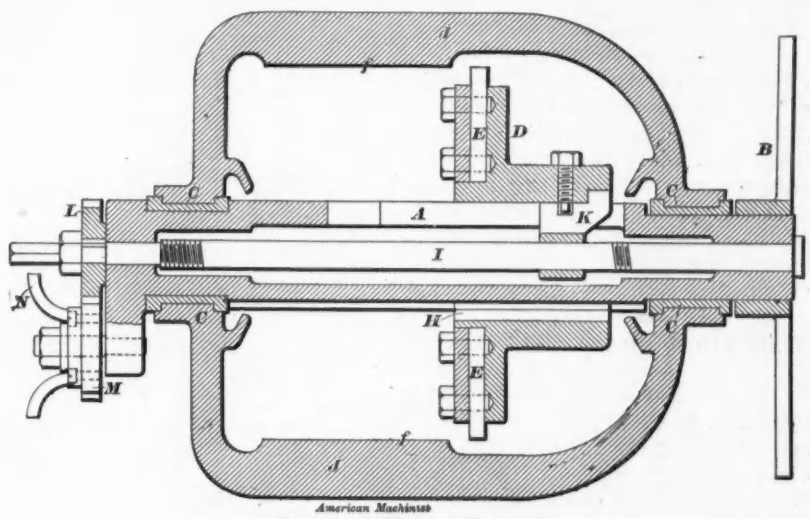
Fig. 18.

REGULATION OF STEAM ENGINES.

Link-expansion gear is chiefly identified with the name of Allan, and was first introduced in Europe at the French Exhibition of 1864. Allan worked, as is well known, with one eccentric; but the most common form of link-expansion gear is that shown in Fig. 17, one eccentric being used to drive the main valve *B*, which thus has a constant lead, compression and exhaust; another eccentric set at an angle to it controlling a separate cut-off *A*, fitted on the back of the main valve. The stroke of this cut-off valve, together with the point of cut-off, is regulated by the position of the valve rod *C*, with the other end of which the cut-off valve is connected. With this type of gear a range from nearly three-quarters to zero can be obtained, together with a very good distribution of steam, as shown by the diagrams, Figs. 16 and 18, taken from an engine fitted with this gear. Its success depends very much upon the type of governor used in conjunction with it, which must have a wide margin of stability.

With the governor shown in Fig. 17 there is no need of a dash pot, the change of position occurring instantaneously and the acceleration of speed being a matter of one or two seconds only. The stability of the governor is very great, and although the arms, balls, and spindle together weigh only 53 pounds, yet it would require a force of over 400 pounds to move it to its highest position when at rest. When it is running at a speed corresponding to its lowest position, a force of 216 pounds would be required. With an acceleration of only 4 per cent. it overcomes a further pressure of 200 pounds. The balls move outward in a practically straight line in the same way as the balls of the governor shown in Fig. 5.

The higher pressures necessitate the use of valves which will work in equilibrium or nearly so. These are mainly of three kinds—piston valves, rotating or circular valves, like the Corliss, or double-beat valves, like that in Figs. 19 and 20. Slide valves absorb a great part of the power of an engine working with high-pressure steam. The author has made a series of experiments showing the amount of this friction, but would now only state that his experiments show it to absorb often more than 10 per cent. of the whole power exerted by an engine; while the power required to work the equilibrium valves shown in Fig. 19 is quite insignificant, and is almost independent of the pressure of steam used. This type of valve is much used in connection with a variety of valve gears. That shown in Figs. 19 and 20 is believed by the author to combine many advantages not secured by the others. It consists, Fig. 20, of a double-beat valve *A*, guided by a central stem. The valve is lifted by the steel stem *B*, at the upper end of which is a grooved piston *D*, working practically air-tight on the cylinder D^1, a light spring pressing it down. A small hole at the bottom of the cylinder is in communication with the upper part of a valve box *C*, in which works a small ball valve. The valve is shown in section at *D*, and to a larger scale at C^1. The object of this piston and cylinder is to control the valve as it descends upon its seat, and thus to prevent a disagreeable noise and unnecessary wear. As the spindle with its piston and valve rises, air is drawn in through the valve *E*, when it is suddenly relieved and falls, the contained air moves slowly through a fine hole in top of the valve casing, and the valve *A* is relieved of inconvenient shock. The peculiarity of this gear lies in the method by which the point of cut-off is controlled by the governor. The valve spindle *B* is lifted by the lever *H* when the outer end of the lever is depressed. This depression is caused by the eccentric *K*, which revolves in equal times with the engine shaft. The upper end of the eccentric rod is attached to a pair of rocking levers *J*, and also carries a tripper with a steel toe *L*. As the rod rises, this toe is thrown back, but as soon as it gets above the levers it is allowed to fall to its original position. On the downward stroke of the eccentric the toe of the tripper depresses the lever, raising the valve, until, being pushed out by radius rods, it releases the lever, and the valve instantaneously falls upon its seat. It will be seen that the more the toe of the tripper overlaps the end of the lever *H*, the longer it will remain in contact with it on the downward stroke, and thus the valve will remain so much longer open while the lead remains constant. The amount of the overlap is regulated by the governor in a very simple manner. The fulcrum of the lever *H* is movable, and can be moved from right to left in a straight line in the slot *M*. The spindle *O* has two levers upon it, connected by short links *P P* to a rod *Q* passing through both fulcrums. The entire movement required is a horizontal motion of this fulcrum, and even in large engines of, say, 500 horse-power, it is only about ¼ inch, and can be moved with the smallest effort. There is, therefore, absolutely no stress upon the governor, and not the slightest tendency for it to work or jump due to the working of the valve gear. So far from this being the case, when the valve is lifted, the fulcrum is pushed down and so held rigidly in position, the movement of the fulcrum having to take place during the interval when the valve is not being lifted. The range of expansion which can be obtained by this means is very large, extending from zero to seven-eighths, and is shown in the diagrams, Figs. 21 and 21a, taken from an engine fitted with this gear. An important advantage possessed by this valve gear results from the fact that it allows of the engine being stopped immediately by merely raising the governor lever, and if a cord from the end of the lever is carried into every room in a factory or a mill, in the event of accident the engine can then be stopped by merely pulling the cord even from a great distance.



BORING A MOTOR FRAME.

Boring a Motor Frame.

In recent years the price of electrical machinery has been greatly reduced; an important factor of success to the manufacturer is to reduce the cost of production. The following is a description of a boring bar, designed for boring the pole pieces of an iron-clad street-car motor frame. It proved to be cheap of construction and manipulation and quite efficient. The frame *J* was much like a cocoanut, cast in two halves, with bearings for a shaft to run through its greatest diameter, and large spots to be finished inside at *f*. The principal tooling was the boring of seats for heavy bronze boxes and the pole pieces, after fitting and bolting the two halves together. The box seats were first bored to gage in a horizontal boring machine at one setting.

Temporary boxes *C* were fitted into these seats, with an internal diameter to fit the boring bar; these boxes were put on in halves, and one situated between fixed shoulders received all the thrust. The bar proper, *A*, was a hollow cylindrical steel casting. The ends were reduced in diameter for journals. A cored slot ran nearly the

entire distance between the journals. Outside the journal, on one end, was pinned a driver *B*—simply a hub with two arms—to be driven by two bolts fastened to a face plate. Outside the other journal was cast a short arm, which carried a gear *M* by a stud. On the side of the gear was attached a star *N*, the points of which were offset from the side of the gear. The points of the star hit against a stationary stop when the bar was in operation. In mesh with this gear was a gear *L* keyed to the feed screw *I*, which ran concentric through the bar. The gear end of the screw was squared to receive a crank handle to turn the screw back. The ends of the bar were bored to form bearings for the feed screw. On the feed screw ran a bronze nut *K*, with an arm or lug on the side projecting through the slot in the bar. The nut drove the cutter head by contact with its hub. A hole in the arm of the nut engaged loosely a stud in the cutter head hub to bring the cutter head back to the beginning of the feed. The cutter head *D* was shaped like a face place; the hub fitted the outer diameter of the bar, which contained a keyway. In this keyway ran a feather *H* dovetailed to the hub of the cutter head. In the face of the cutter head were cut four or five radial grooves to fit square tool steel. The cutters *E* were firmly held by straps and screws in the manner of planer tools. The bar was operated by simply dropping it into its place between the upper and lower halves of the frame casting, then bolting the halves together and strapping the whole on the carriage of a lathe. After properly setting the cutters there was no aligning or adjusting to do. It seems evident any other casting with desired boring between two bearings may be so finished.

New York. J. LANDSING.

LETTERS FROM PRACTICAL MEN.

Design of a Cam.

Editor American Machinist:

Reading Mr. Redfield's article on "Cam Motion and Design," in your issue of July 18th, brought recollection of a cam motion designed by myself a year or so ago, and which has properties peculiar enough to interest your readers possibly.

The object was to design a mechanism that would transform a uniform rotary motion into an intermittent motion. Evidently the cam shown in Fig. 2 of Mr. Redfield's article would do this, for it is bounded over two portions of its periphery by circular arcs, concentric with the axis of rotation; but the rest of the construction would not answer, for a positive motion of the yoke being essential, this latter must encircle the cam as shown in Fig. 1, thus insuring that at all times the yoke has only the motion imparted by the cam to it.

This construction necessitates two things: that the two circular arcs be symmetrically placed with respect to the axis, and that they subtend equal arcs at the center, and that the distance between any two parallel tangents be constant, for otherwise the yoke would either bind or run loose at times. The velocity diagram is not of paramount importance in this case, providing the changes from rest to motion and *vice versa* be gradual, and no particular velocity ratio was aimed at in the following construction:

On any line *M N* some point *o* is assumed as origin, and through it two lines *A D* and *B C* are drawn, making equal angles with *M N* of such magnitude that the ratio of the angles *B o A* and *A o C* is equal to the required ratio of time of rest to time of motion.

The arcs *C D* and *A B* are described about *o* as center, and with radii *R* and *r*, so chosen that

$R + r$ = width of slot in yoke = *d*, Fig. 1, and that

$R - r$ = the throw of the cam.

Two lines, *p s* and *q t*, equal to *r* and *R* respectively, being drawn perpendicular to the extremities of a line *p q*, Fig. 3, two arcs *s f* and *t f* are drawn with *equal* radii *k s* and *t l*, and centers on *p s* and *q t* respectively; these arcs are drawn tangent at *f*, and the requisite construction may readily be seen from Fig. 3.

The angles *A o C* and *B o D* of Fig. 2 are divided into any number of equal parts, and the base *p q* of Fig. 3 is divided into the same number of equal parts, and at the points of division, 1, 2, 3, etc., perpendiculars erected cutting the curve *s f t* in the corresponding points 1, 2, 3.....

Now on the radius *o I* of Fig. 2 *o I* is laid off equal to 1 1 of Fig. 3; *o II* equal to 2 2; *o III* to 3 3, etc., and at *I* a perpendicular erected to *o I*; at *II* a perpendicular to *o II*, etc. These perpendiculars are tangents to the required curve, which can now readily be filled in. A simple inspection of the figures will show that the distance between any two tangents is the constant quantity, $R + r$. In the construction *p q* is given as of any length, but as *p q* varies, the shapes of the resultant curve and of the velocity diagram vary slightly, changing its length being in fact equivalent to using arcs of equal ellipses of suitable diameter and eccentricity instead of arcs of circles for the limiting curves of Fig. 3.

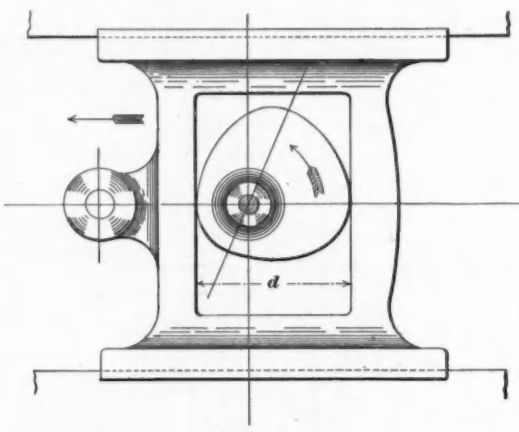


Fig. 1

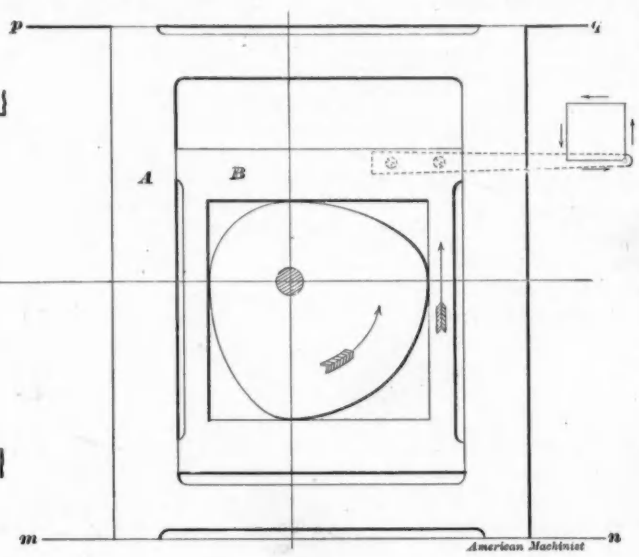


Fig. 4

This cam has peculiar properties if constructed with the angles *B o A* and *A o C* equal to each other and to 90 degrees, so that the times of rest and of motion of the yoke are equal, for if such a cam be placed in the square opening of a yoke so adjusted as to permit its translation in any direction but not its rotation, the sides of the opening being each equal to $R + r$, a continuous rotation of the cam will be transformed into a "disjointed," continuous motion of the yoke and of every point in it along the sides of a square.

Fig. 4 is an outline drawing of a working model of this train; for the 90-degree motion of cam next succeeding the position shown, *A* will remain still, the piece *B* moving in the direction of the arrow. After 90 degrees and before 180 degrees of rotation, *B* will have no vertical motion, but *A* and *B* together will move to the left, similar motions in the opposite direction taking place during the next two periods of 90 degrees when the cycle will be repeated. Thus there is imparted to every point in *B* a motion along the circumference of a square whose sides are equal to the throw of the cam.

JOSEPH COTTIER, M. E.

Jersey City, N. J.

Elastic Cylinder Head Bolts.

Editor American Machinist:

Anything surprising need not necessarily be startling, but anything startling is pretty apt to be surprising, consequently in this condition I find myself, after reading A. S. Richardson's startling statement in your issue of August 8th, that the cylinder head bolts of his 16"x32" engine stretched "at least ⅛ inch" when the water from his foaming boiler got backed up in the cylinder, and then because of their resiliency they brought the cylinder head back to a tight joint again.

As if he was fearful that he had said something altogether wild, Mr. Richardson ends his letter by remarking, "I will add that the only thing that saved the head at the time was that we had put a relief valve on each head in anticipation of such an occurrence."

My opinion of relief valves, *per se*, is that they are all right, but as applied to an engine with cylinder head bolts of the quality such as Mr. Richardson has, they are certainly useless, and I should advise him to remove them.

It is the duty of every correspondent to bear in mind that a letter published in your most excellent journal goes to the four quarters of the globe, and is read by the initiated and the uninitiated alike, and such unqualified statements as he makes produce bad impressions oftentimes, and tend to lead the inexperienced astray.

I speak feelingly about relief valves and foaming boilers, for I remember a sample I had some years ago in Ohio, at a large new flouring mill, where I had just erected the second high-speed automatic cut-off engine ever built west of the Allegheny Mountains* and it was being watched with a great deal of interest in that part of the country, especially by the millers.

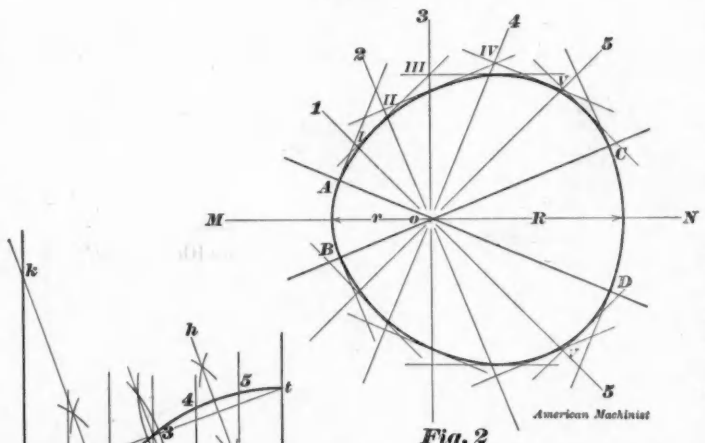


Fig. 2

DESIGN OF A CAM.

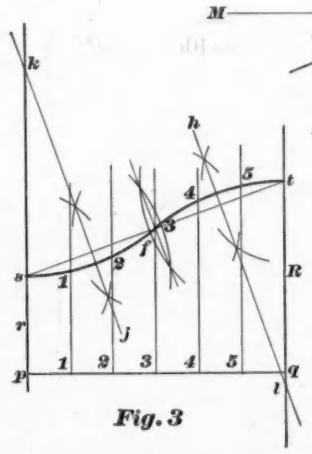


Fig. 3

The head miller had instructed me not to shut the engine down, under any circumstances, without first giving him warning, and for that purpose a large gong was placed in the mill with a chain connecting with the engine room.

I had been fearful of priming of the new boilers for several reasons, and was in that unenviable state of mind that others have been in before when one realizes he is about through with his job, yet still is not quite "out of the woods" with an acceptance signed and tucked in his pocket, yet the wheels must be kept turning ten hours a day, hot journals or foaming boilers to the contrary notwithstanding, when, to my disgust, the water started without warning. It would have startled a deaf man, and his impression would have been that bolts, nuts and about every rivet in the boiler were loose and coming over with the water.

Naturally the first thought was the throttle, but no, orders must be obeyed, and that d—— ucid gong had to be rung, and rung it was, but at the expense, somewhat, of a sprung eccentric rod and connecting rod keys, etc.

Now to think that after these years I learn that the only thing lacking to have avoided this expense and annoyance was the proper kind of cylinder head bolts to stretch and relieve the cylinder; for relief valves were not thought necessary for such an engine at that time.

I will add that when I was ready to start up again it was found necessary to put a new chain or rope on that gong for, unlike Mr. Richardson's bolts, it did not stretch enough when pulled with a foaming boiler energy, but had broken.

Mr. Richardson's sober question is, should a relief valve be placed at the bottom of the head or in the center, to be the most serviceable? In my opinion, it is grasping the wrong end of the whip by remedying a priming evil through the medium of a special fixture or valve. It shows that the plant is abnormal in some feature, otherwise the exhaust valves and drip cocks should take care of occasional priming.

The abnormal feature in my Ohio case was the crowding of a new battery of tubular boilers which had of necessity to be set on a higher level than the engine.

Now if relief valves must be used as a last resort I believe it will make no difference with their efficacy whether they be put in the center of the head or somewhere else.

OROSCO C. WOOLSON.

Lathe Speed Regulator.

Editor American Machinist:

During a recent visit to the Brown & Sharpe shops I was much pleased with the operation of a device by which the speed of a lathe was kept uniform, no matter what the diameter of the piece being turned. As it is, on ordinary lathes, when the tool is working far from the center (say, on a cylinder head or other disk-shaped piece), the cutting speed is greater than when it is working close to the center; and it is evident that, especially on large pieces, if the lathe is geared so as to give the proper cutting speed, when the tool is at or near the center, the speed will be too great when the tool is working further out, and may be ruinous when at the edge of a piece.

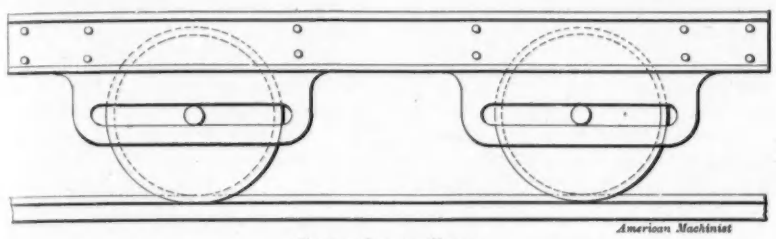
On a piece 18 inches in diameter, if the speed is right when working 1 inch from the center, the average speed will be five times too great, and the maximum speed nine times too great, which would be ruinous to the tool.

If we get at it the other way, and to prevent injury to the tool, and improper work, make the cutting speed right for the periphery of the 18-inch disk, the average speed, which will represent an approximation to the capacity of the lathe, will be only one-fifth as large as it should be, and the speed at 1 inch from the center will be one-ninth

* The first one ever built West was erected by Mr. Woolson, in Chicago, a few months before this.

of what it should be. That sort of thing may be very satisfactory from the standpoint of preserving the tool points, but it does not help along the capacity of the shop to get work done, nor aid in satisfying customers who want their work (as most of them do) in a hurry.

If, however, we have a belt-shifting device consisting of two horizontal belt cones placed almost in contact, the head of one opposed to the foot of the other, and a space between them rather less than the thickness of an endless rubber belt having a length rather more than the greatest circumference of the cone about which it wraps, rotation of one cone (by "cone" I mean straight-sided conical frustum, not stepped pulley) will cause rotation of the other; and sliding the belt along from one point in the length of the two cones to another, will vary, and even if desired reverse the velocity ratio. If the belt be embraced by the prongs of



CORE OVEN CARS.

a shipper which engages in an advancing spiral parallel with the cones, rotation of the spiral will cause variation of the velocity ratio; and if the spiral be specially designed with irregular pitch, any desired rate of change of the velocity ratio between the two cones may be obtained. If the driven cone be belted to the lathe gearing, and the prong which engages in the advancing spiral be attached to a piece which bears against the tool, or the tool post, or the cross slide, the motion of the tool outwards from the center may be made to cause decrease of the speed of the driven cone, so that when the tool is working on the large diameter the cutting speed may be kept just the same as when it is working on the small diameter. The illustration shows this most satisfactorily.

G.

Core Oven Cars.

Editor American Machinist:

There is rather a good thing in core ovens in the shops of the Straight Line Engine Company, where, indeed, one can get a hatful of wrinkles in short order. This concern has a large core oven with four rails for cars, equal distance between centers. There are two cars half the length of the oven. They can be set side-and-side for large square or round cores, or end-to-end, or either of three places for round cores. The journals are arranged to run without oil. The slots for the journals are long enough to permit the cars to run twice the depth of the ovens before reaching the end. The wheels have the flanges outside the rails only, which is all right for cranes or cars of this kind where they run on straight tracks. The inside flanges, when they hit the rail at all, are considered to do more harm than good.

Holding Large Drawings on the Board.

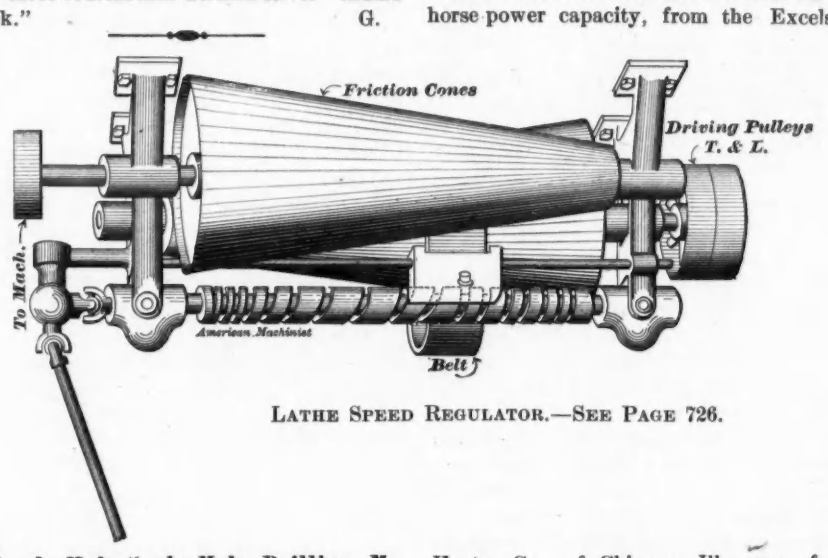
Editor American Machinist:

Since going through the Pennsylvania railway shops at Altoona, a number of years ago, I have given up the old barbarism of holding large drawings on the board by glue or by drafting tacks, and have used small copper tacks (about the "one-ounce" size) as being cheaper and more convenient to insert and take out, and as offering no obstruction to the passage of the T square and the triangle; besides which, they have not the habit as some have, of coming up into one's thumb (whence the name of "thumb tacks" I suppose) on being pressed into a hard board.

But in the Brown & Sharpe drawing rooms, where I knew that they had also been using for some time the ordinary copper tacks, I saw something which they say is better yet, and which for many things is supplanting the copper tack way. They use small slips of gummed paper about three-fourths of an inch or an inch long and one-fourth of an inch wide, and these make as firm a connection as is desired between the edge of the drawing or tracing and the board.

I think that it was in 1866 that I first learned to revile the memory of the inventor of the system of "double elephant" size of "egg-shell" paper (usually mounted on muslin) glued tight to the board. When a drawing was put under way there was always a margin of about one and one-half inches all around, allowed for the gluing, and then about another inch or inch and a half inside that there came a marginal line which it was the correct thing to make double, with corner pieces of greater or less complication. The outer inch and a half of width we used for trying our drawing pens, etc.; this part having the advantage that it was exactly the same quality as the surface on which we were to work. Thank heaven, those days have passed away, and with them the three-fourths inch German silver "thumb tack."

G.



LATHE SPEED REGULATOR.—SEE PAGE 726.

Bicycle Hub, Spoke-Hole Drilling Machine.

We illustrate herewith a machine for drilling the holes for spokes in the flanges of bicycle hubs.

The hub to be drilled is held in a revolving chuck, which is fitted with an index for 14, 16 or 18 holes, and there are removable jaws which grip the hub by the barrel, and may be made to fit hubs of any model. The chuck is held in a hinged frame, and the arrangement is such that the work can be very quickly put in or taken out.

There are two sensitive drill spindles, which are placed exactly in line with each other, and are fed up by the movement of a single lever. The drills pass through jig bushings which prevent springing and breakage of drills; there are depth stops, and the spindles automatically return to position when the lever is released.

The machine is built by the Garvin Machine Co., Canal and Laight streets, New York.

Atlanta Exposition Notes.

That the prominent machinery manufacturers of the country are interested in the Cotton States and International Exposition is very evident from the extent of the Machinery Department as shown not only by its size but also by its scope.

The Machinery Building is one of the largest buildings on the grounds, and has a very fine location, facing, as it does, the beautiful artificial lake Clara Mere, and situated directly opposite this lake from the Agricultural Building. Those interested in a mechanical class of work will also find much entertainment and instruction in many of the other buildings, such as Electricity, Transportation, Forestry and Mines, Manufactures, and the Government Building.

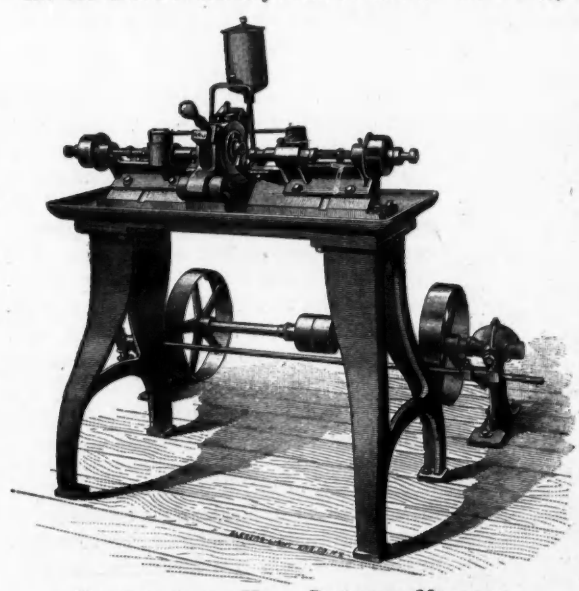
The Machinery Building is 486 feet long by 100 feet wide. The power plant occupies the middle of the floor—a space about 280 feet by about 40 feet. This space is devoted entirely to the steam plant for furnishing all the electrical and mechanical power which will be required upon the grounds for all purposes excepting water service.

The boiler house is built as an annex to the main Machinery Building which it joins, it being 70 feet wide by 220 feet long. The boilers are from the Stirling Company, of Barberton, Ohio. There are eight of them made up into four batteries, three of 500 horse-power, and one of 750 horse-power, commercial rating.

The boilers will be fed by eight boiler-feed pumps, as follows: Four from Henry R. Worthington, Brooklyn, N. Y., one 9"x6"x6", Admiralty pattern; one 9"x5¼"x10", regular pattern; one 9"x5¼"x10", piston pattern, and one 9"x5¼"x10", pressure pattern. John H. McGowan Co., of Cincinnati, Ohio, one 10"x7"x10", duplex. Laidlaw & Dunn Co., of Cincinnati, one 9"x5¼"x10", duplex. Deane Steam Pump Works, of Holyoke, Mass., one 10"x6"x10", duplex, and the A. S. Cameron Steam Pump Works, one of their No. 7 pumps.

For heaters there are one Excelsior of 500 horse-power capacity, from the Excelsior Heater Co., of Chicago, Ill.; one of 750 horse-power from the Harrison Safety Boiler Co., of Philadelphia, Pa., and a second, of 500 horse-power, furnished by the Adams Boiler Co., of Cleveland, Ohio.

All the above machinery is in the boiler house. That in the Machinery Building proper has been divided into three distinct groups, which for convenience are designated as follows: 94-foot block, which contains all the engines and dynamos for supplying current for incandescent lighting; a small part of the output of this group will be used for furnishing current for power to exhibitors. This block also contains the engine for driving the line shafting of the building.



BICYCLE SPOKE-HOLE DRILLING MACHINE.

The Worthington pump block, as its name indicates, contains the six Worthington pumps which are to supply water for the electric fountain. These engines, their arrangement and connections, will be described fully later, and hence will not be referred to again.

The last is called the 95-foot block, and contains all the engines and dynamos for all the arc lighting of the grounds and buildings; also the machine for supplying electricity to the electric fountain; also the machinery which will supply the great bulk of electric power for distribution about the grounds.

The machinery for the 94-foot block is as follows: A 20"x48" Eclipse Corliss engine from the Frick Co., Waynesboro, Pa. This engine will drive the line shafting of the building; a 22"x48" Lane & Bodley Corliss engine, which will drive a 250 kilowatt General Electric alternator; two 14"x24"x18" Westinghouse engines to run direct, connected with two alternating generators from the same firm; two 5 horse-power direct connected exciter engines and dynamos from the above firm; one 50 horse-power Junior engine with dynamo, also from the Westinghouse Companies, these last two machines to connect with a belt. There will also be in this same block a 14"x24"x16" Harrisburg "Ideal" from the Harrisburg Foundry and Machine Works, which will drive direct connected a 160 kilowatt Fort Wayne alternator. A 100 horse-power gas engine from the J. I. Case Threshing Machine Co., of Racine, Wis., will drive a 60 kilowatt alternating machine from the Standard Electric Co.

In the 95-foot block the engines are as follows: A 14"x18" Frick automatic engine belted to an Edison bi-polar dynamo for furnishing current to the electric fountain; a 14"x12" engine from the Ball Engine Co., of Erie, Pa., will drive a 125 arc light Brush dynamo; a 15"x16" Straight Line engine (Syracuse, New York) will drive a Brush machine of the same style as that on the Ball; a 125 horse-power engine from the American Engine Co., of Bound Brook, N. J., will be belted to a 125 light arc machine from the Fort Wayne Electric Corporation, of Fort Wayne, Ind., next a Lane & Bodley vertical cross-compound engine of 80 horse-power will run direct connected to a Card generator. The next engine is a Houston, Stanwood & Gamble, 15"x22½"x22", which will run a 125 light Excelsior arc dynamo. The last engine to be mentioned in this block is a 14"x28"x24" Buckeye, which will be employed to run a 200 horse-power electric power generator from the Jenney Electric Motor Co., of Indianapolis, Ind. The installation work on the power plant is progressing favorably, and if all who are to furnish material will keep their promised dates of shipment, there can be no doubt that all the material not already in place will be securely installed by the 18th of September, the day for the opening.

Piedmont Park, Atlanta, Ga., August 28, 1895.

Jigs and special tools, such as cradles, gages, etc., may, if large enough and with some unpolished surfaces, be painted vermilion, as with shellac varnish, which is renewed and dried when the tool has become dirty. This marks them out in distinct contrast from various castings and other pieces of metal around the shop for which they might be mistaken, and enables them to be very easily found. Especially is this the case where some of them consist of castings which are duplicates, or nearly so, of some of the castings which are component parts of the product being manufactured. This happens sometimes in the case of using a casting as a sample or test gage to which to fit other parts.

The experience with this method in the Ferracute Machine Co.'s Works has proved its great convenience.

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CONTENTS.

PAGE.

A Foundry Sketch—Low-Priced Work..... 721
Some Good Steel Castings. By Gus. C. Henning..... 722
Sextuple Electric Radial Drilling Machine..... 723
Production of Aluminum..... 723
"The Mechanical and Electrical Regulation of Steam Engines."—I. By John Richardson.... 724
Boring a Motor Frame. By J. Landsing..... 725
Letters from Practical Men: Design of a Cam. By Joseph Cottier, M. E....Elastic Cylinder Head Bolts. By Orosco C. Woolson ...Lathe Speed Regulator. By G ...Core Oven Cars—Holding Large Drawings on the Board. By G 726, 727
Bicycle Hub, Spoke-Hole Drilling Machine..... 727
Atlanta Exposition Notes..... 727
Architect's Machine Design..... 728
The Engineer Makes History..... 728
A Modern Canal for Modern Boats and Traffic. 728
British and Continental Iron Works Engineering..... 728
Literary Notes..... 729
Questions and Answers..... 729
Ring Oiling Device for Bearings. By M. A. Chine..... 729
Screw Pitch Gage..... 730
Death of Herman Winter..... 730
New Catalogs..... 731
Manufactures..... 731
Machinists' Supplies and Iron..... 731

Architect's Machine Design.

A casual glance at a new typewriter which has recently been brought out, imparted a disagreeable sensation, the cause of which there was then no time to analyze, but a little later, in looking over a circular, we came upon the explanation in the following description of the machine: "In general appearance it is absolutely different from any other machine now in use, and far handsomer. The frame was designed by * * * * , architect of the Art Building, and Peristyle, of the World's Columbian Exposition."

There can be no shadow of doubt but what the architect referred to is a master in his art, and it must be admitted that his design of a typewriter frame is "handsome" architecturally, but it is a lamentable fact that he evidently does not know that it is a monstrosity applied to a typewriter. It must also be discouraging to competent designers of machinery to have this additional evidence that business men will pass them by in their own profession to take up with someone who has acquired a national reputation as the designer of a world's fair building. There is, however, compensation in the knowledge that such work cannot endure. The machine in question will attain no great success until this overshadowing blemish is removed, and the promotors of the enterprise are hastening its end by concentrating attention upon it. If we were to offer advice to the manufacturers of this machine we would suggest that they first call in and destroy every circular put out, and then employ some experienced machine designer to design a frame that would be in harmony with the uses to which it is put.

Architectural ideas, for well understood reasons, dominated machine design during the early part of the century and some remnants of them may still be seen in machinery produced in remote districts, but greater experience and broader knowledge have swept these away in the great centers and filled their place with designs that are truly and distinctively mechanical in their conception. There is an art in designing buildings and an art in designing machinery, each has its proper sphere, yet both rest upon the fundamental principle that every design, no matter what its character, should be in harmony with the material in which it is to be executed and the uses to which it is to be put.

Much of the crudeness apparent in the machine designs of the present is doubtless due to the fact that the art of designing in iron is still in its early and formative stages, and there are comparatively few who clearly perceive what is appropriate and what is inappropriate. So far there appear to have been evolved but two styles, yet unnamed, that deserve to be perpetuated.

The hollow pedestal may be taken as the type of one of these and the I-beam of the other. A machine having all of its parts in one or the other of these will be harmonious in its style though it may be illy-proportioned and lack grace of form; but any design that mixes the two in one machine can be but a mongrel, no matter how meritorious it may be in other respects.

It seems a little curious that a highly trained and skilled architect should seem to think that principles of design which are fundamental in architecture can be utterly disregarded in machine construction, and that a handsome bird-house can be reproduced in iron to form a handsome frame for a typewriter.

There are a number of frightfully ugly typewriters on the market, but there are also some very neat and handsome ones, and in every case the ones that are most pleasing in appearance will be found to have frames designed in harmony with the material of which they are made, and for the evident and sole purpose of effectively supporting the working parts of the machine in their proper positions.

A machine frame, made of cast-iron, in a form suggesting masonry and carved stone work, is a monstrosity and when finished by the Bower-Barff process, or by copper or silver plate, it becomes a horrible nightmare.

The Engineer Makes History.

The writing of history may not be anticipated. The record of man is always retrospective. With the birth of a child we cannot announce that here is one of the great minds, one of the leaders of men, one whom all ages shall honor. Only after he sleeps in the tomb may his life work be summed up. So of the age, those who come after it must tell the story of it. But if history makes record of changes it is surely given us to know that the changes are going on, though we may not know the tendency and magnitude of them. We may well look around us to-day and ask if ever there were agencies of change more active and powerful than are now in operation.

Heretofore men have fought men, but to-day it is man against nature, and a greater victory awaits us. History, it would seem, must be made hereafter without the horse. Was there ever a greater transformation than this? For locomotion we are fast becoming absolutely independent of the long-trusted steed. Not even in war can he long serve our purpose, as our weapons are to be so deadly and our methods so destructive that the "clash of arms" is hereafter pure fiction. The steam engine has held mighty sway for a century, but who can believe that it can survive for a second hundred years? Gas and oil engines, crude in design and construction, are challenging the best heat economy of the most elaborate steam engines, and they are putting the possibilities of power into the hands of the many against the few. The small shop or factory may have all the advantages of the large establishment and the added glory of independence. The wonderful gas acetyline is a cheap and handy key to a myriad of processes and products, and it is yet too early to record even the promises that it makes to man. The supreme wonder-working fluid, electricity, it has only been given to the present generation to harness and control, and none even yet has measured the fullness of its powers. It carries light and power wherever man may want them, and gives it out in the minutest subdivision or in volumes of any magnitude. The wonderful achievements of the age are those of the investigator, the inventor and the mechanic, or, if the word be better, *the* engineer. It cannot be otherwise than that the habits of all the people and the consequent course of events must be greatly changed by the agencies now operative and but lately let loose. We cannot think the old thoughts or live the old life any more. A larger future opens for every human being, and the race is evermore drawn more closely together. Distance is annihilated, each minute is more fruitful in accomplishment, and the end is farther than ever.

A Modern Canal for Modern Boats and Traffic.

In our issue of August 8th we noted the launching of the first steel canal boat built by the Cleveland Steel Canal Boat Company. A fleet of these boats, comprising a steam propeller and five consorts, left Cleveland on August 11th, and arrived in New York August 29th. The cargo consisted of 1,285 tons of rails for the surface roads of New York City and Staten Island. The consorts are each 96½ feet long, 17 feet 11 inches wide, with a molded depth of 10 feet, and they carry 230 tons on a draught of 6 feet of water. The propeller contains a fore-and-aft compound-condensing engine with cylinders 10 inches and 18 inches diameter by 16 inches stroke, supplied by a single Scotch boiler. The engine is rated at 120 horse-power, and is capable of towing the fleet at about 6 miles an hour in deep water. Considerably less speed than this was made on the trip as much caution was required in traversing the antiquated canal. The progress of the boats was marked by great enthusiasm along the entire length of the canal. The people appreciate the importance of the event. The boats will traverse the lakes as well as the canal in safety, and without breaking bulk can go from Lake Superior to New York, carrying their freight at one-half the rate of any railroad, and with equal surety. All this is possible with the present canal, and the date of the canal is 1825. It would seem that nothing more could be said as to the rights of the canal, and of the people of the nation to the use of the canal, than the mere mention of the date of its building. The Suez, the Manchester, the Northeast sea canals, all attest that the present is not the day of the great canals' desuetude, and the unsalted seas in the heart of the Continent, and the people that dwell around them, with the products of the prairie and the forest, and the wealth of the mines, demand an adequate highway. We have the most superb waterways in the world from the center of our vast Continent to the seaboard, so that from Duluth to Liverpool or Havre, and through the Mediterranean, a richly freighted ship might go without disturbing its cargo, except that it cannot cross the State of New York, and none is a greater loser by the embargo than New York.

British and Continental Iron Works Engineering.

Proprietors of English iron and steel works are at present greatly exercised by the revelations that are coming to them of the superior engineering of German and Belgian establishments. A committee of the British Iron and Steel Industry has visited the chief centers of the iron trade on the Continent, investigating the relative competitive positions, and they report that German iron works especially are at present far in advance of the English in the manner in which they are "engineered," or equipped with machinery, and it is asserted that the English proprietors must face a considerable outlay for new machinery to be able to hold their own in the race. Lower wages, longer working hours and cheaper freights, it is found, by no means explain the German advantage, and what has heretofore been more or less mysterious seems now to be much clearer. The responsibility for the situation does not lie with the inventors and builders of machine tools in Great Britain, but with the purchasers and users of the tools who have been too backward in availing themselves of the advantages offered. We may expect to hear of considerable additional business developing among the English engineering works. While these revelations and incitements to improvements are in progress it would undoubtedly be well if American manufacturers had also some means of taking their measure. Our constant complacent assumptions of superiority of methods and advantage of conditions may be all right, but they should rest upon a firmer basis of actual knowledge. There is nothing like having a good foundation, and one of the best war maxims is: "Never despise your enemy."

The citizens of New York are to be congratulated upon the proposed general extension of the underground trolley system by the Metropolitan Traction Company. The system has been a self-evident success from the first day that the cars began running. They have stood the various vicissitudes of the summer weather, including heavy thunder-storms and sudden rains, without interruption, and there can be little doubt that they will also be able to overcome all the difficulties of our winter seasons. The system has had every possible advantage in the way of exhibition thus far. The cars are roomy and handsome, and splendidly lighted at night. They run through broad avenues, and have very little interruption or interference from street traffic. The cars are without fenders, and as clear as possible of everything under the front clear in to the wheel guards. The brakes are as prompt and quick as any that have yet been seen upon electric cars.

Literary Notes.

The Machinery Molders' Journal has been revived under new management, and the first number of Vol. X. reaches us in enlarged form, and containing a number of articles of interest to foundrymen especially. It is now published by McClung & Co., Pittsburg, Pa.

Questions and Answers.

Questions of general interest relating to subjects discussed in our columns will receive attention in this department. The writer's name and address should always accompany the question. Neither correct initials nor location will be published when there is a request to that effect. If questions are enclosed with a business communication, they should be written on a separate sheet. We cannot undertake to answer questions in "next issue." This department is usually crowded, and questions must wait their turn to be answered. Neither can we undertake to solve mechanical or engineering problems, and send answers by mail.

(337) R. A. J., Minnesota, writes: I would be pleased to know if there are any books treating on gasolene motors. *A.*—We do not know of a book which treats on this subject exclusively. We cannot give you the address asked for.

(338) B. W., Cleveland, Ohio, asks: What process is used in the manufacture of armor plate? Is it rolled out or forged? *A.*—Both rolls and steam hammers are used in the manufacture of armor plate, depending upon the size and shape of the ingot operated upon. At the works of the Bethlehem Iron Co. they use rolls, the largest steam hammer in the world and hydraulic presses. 2. Please give me the names of colleges where marine engineering and naval architecture are taught. *A.*—The only school we know of in this country where these branches are taught is the Cornell University, Ithaca, N. Y.

(339) W. D. M., Garfield, N. J., writes: If the time during which the exhaust valve remains open be reduced to one-half, what proportional amount of steam will remain in the cylinder? I wish to find out if the extra amount of steam which does not have time to escape on account of the speed of the engine being doubled, will be sufficient for a cushion at this increased speed. *A.*—To obtain the required amount of cushion or compression as you propose to do is a case of bad engineering. The area of the steam ports should be proportional to the speed of the engine as well as proportional to the area of the cylinder, and if made too small it will interfere with the admission of the steam, and this is what you propose to do. In many engines the steam ports are too large for the work they have to do, and should this be the case in your engine you may increase the compression very slightly by the increased speed. We cannot give a rule for determining the compression under the condition you name, the only reliable way of determining the compression is by attaching an indicator to the cylinder.

(340) R. F. B., Chicago, writes: Will you inform me of the cheapest and best way of reducing a malleable metallic alloy to a powder of about the consistency of drillings from cast-iron? The alloy has somewhat the physical properties of zinc. *A.*—The process by which tin is granulated might work with your alloy, and we advise you to try it. A suitable quantity of tin is thoroughly melted in an iron ladle deep enough to give liberty for the subsequent operation. When the tin is completely melted the pot or ladle is removed from the fire and allowed to cool. As the metal begins to solidify, or a little before that, it is stirred briskly and constantly with the result that the metal is finally left in minute particles. Sometimes the partly solidified metal is thrown into a strong cloth, quickly wrapped up like a pudding in a bag, and pounded all over with a stick or mallet. The tin after it is thoroughly cooled is sifted through a sieve of the desired fineness, and what is too large may be remelted and the granulating process repeated. Metals are sometimes granulated by melting and pouring through a broom into water.

(341) J. S., Auburn, N. Y., writes: In computing the strength of boiler sheets why do we use the total steam pressure per square inch for the shell, and one-half of this pressure for the heads and flat surfaces? *A.*—We do not do anything of the kind, we use the full steam pressure per square inch in all cases. You have probably got mixed up in the fact that in the cylindrical shell of a boiler the stress per inch in a longitudinal direction, that is, parallel to the axis, is twice as great as the stress per inch in the circumferential direction. This can be shown as follows: Suppose the boiler is 36 inches diameter, subjected to a steam pressure of 100 pounds per square inch. The force tending to part the sheet on any longitudinal line 1 inch long is equal to one-half the product obtained by multiplying the diameter of the shell by the steam pressure per square inch, this gives us a stress of

$$\frac{36 \times 100}{2} = 1{,}800 \text{ pounds}$$

per inch of length in a longitudinal direction of the shell. The area of the head is 1,017.88 square inches, hence the total pressure on the head will be $1{,}017.88 \times 100 = 101{,}788$ pounds; this pressure is resisted by the circumference of the shell which is equal to $36 \times 3.1416 = 113.09$ inches. Here then we have 113.09 inches to resist 101,788 pounds, consequently each inch of the circumference will have to resist $\frac{101{,}788}{113.09} =$ 900 pounds, which is just one-half the stress per inch on a longitudinal line. This shows the reason for making the longitudinal seams of a boiler stronger than the transverse seams.

(342) Q. E., Pittsburg, Pa., writes: A load gradually applied is just sufficient to rupture a certain beam. What load suddenly applied, but without impact, will produce the same result? If equal to one-half the load, please give the reason. *A.*—One-half the load suddenly applied will produce the same effect as the whole load gradually applied, provided the stress due to the load does not exceed the elastic limit. A bar suspended from one end and gradually loaded at the other end will, within the elastic limit, be elongated equal amounts for each equal increase of load. For instance, if a wrought-iron bar 1 inch square be exposed to a tensile stress of 1 ton, and the elongation is found to be $\frac{1}{50}$ of an inch, then the elongation will be $\frac{2}{50}$ inch when the load is increased to 2 tons, and $\frac{3}{50}$ inch when increased to 3 tons, and so on, provided the elastic limit is not exceeded. The stress in the bar at any instance is equal to the load, and as the load is gradually applied the stress increases slowly from zero up to the final value of the load; if we now denote the final stress (which is equal to the final load) by Q, then, according to the above, the mean stress during elongation will be $\frac{1}{2}\,Q$. A load is said to be suddenly applied when its intensity is the same from beginning to the end of the elongation. But the stress in the bar, in this case also, increases from zero to Q, and the mean stress, or mean resisting force, is also $\frac{1}{2}\,Q$. Let y represent the elongation produced by the sudden load, and let this load be represented by P, then the work performed by the load P during elongation will be $P \times y$, and the work performed in the same time by the resisting force is $\frac{1}{2}\,Q \times y$. But these two works must be equal; hence we have

$$\tfrac{1}{2}\,Q \times y = P \times y,$$

from which we get $Q = 2\,P$. From this it is seen that a suddenly applied load produces double the stress and double the elongation caused by the same load when gradually applied, provided the limit of elasticity is not exceeded. This law is not applicable to the ultimate strength of bars. Laws for the ultimate strength of materials are not well established, and when the engineer has to deal with these he makes experiments, or refers to records of experiments. Fortunately, the engineer does not need to concern himself much with the ultimate strength; his business is to erect safe structures, in which the stress in each member is a fraction only of the elastic limit. 2. From what hight must a load fall to have the same effect as ten times this load gradually applied? *A.*—Let P = load gradually applied, Q = stress due to this load, y = corresponding elongation, $\frac{1}{10}\,P$ = to the falling load, and h = the hight through which the load $\frac{1}{10}\,P$ falls. The work done by the internal stresses during elongation will be $\frac{1}{2}\,Q \times y$, and the work done by the falling load will be $\frac{1}{10}\,P\,(h + y)$. Hence we have

$$\tfrac{1}{2}\,Q \times y = \tfrac{1}{10}\,P\,(h + y).$$

In this equation the numerical values of all the symbols excepting that of h are known, hence substituting these values for the symbols and transposing, we have

$$\frac{\frac{1}{2}\,Q \times y \times 10 - y}{P} = h.$$

3. A weight W is attached to a flexible cord over a frictionless pulley; what force applied at the other end of the cord will be required to raise this weight 20 feet in one second? *A.*—We shall here assume that the weight W starts from rest, and at the end of the second it has been raised 20 feet. A weight raised through the given hight and time must have a velocity of 40 feet per second at the end of the given time, hence in this case the acceleration will be 40 feet per second. The force due to this acceleration is found by the following formula:

$$f = m \times a, \qquad (1)$$

in which f = required force in pounds, m = mass which is found by dividing the weight in pounds by 32.2, and a = acceleration in feet per second. If the weight W is equal to 161 pounds, then the mass will be $161 \div 32.2 = 5$. Now substituting for the symbols in formula (1) we have $f = 5 \times 40 = 200$ pounds for the force to give the weight an acceleration of 40 feet per second. To this we must add the weight of W, which gives us a total force of $200 + 161 = 361$ pounds for raising the weight through the given hight in the given time. 4. If the weight W is counterbalanced by another equal weight at the other end of the cord, what force will be required to raise the weight W under the same conditions as above? *A.*—Let the weight W be 161 pounds as before, then the counterbalance will also be 161 pounds, and the mass set in motion in this case will be $\frac{161 + 161}{32.2}$ $= 10$; substituting for the symbols in formula (1) their values, we have $f = 10 \times 40 = 400$ pounds for the required force.

(343) J. R. G., Richmond, Va., writes: Please give me a method for determining the common center of gravity of a counterbalance consisting of two, three, four, five and six segments for locomotive driving wheels. *A.*—In all the accompanying figures the lines $a\,b$ are horizontal lines drawn through the center of the axle a, about which all the segments of the counterbalances are symmetrically arranged and drawn in their correct positions from the center a and the correct allowance made for the arms of the wheels between the segments; in short, all the segments are drawn in the same relative positions as they will occupy in the wheels. In each figure the point C is the center of gravity of the segment A. In each figure draw an arc from the center a through the center of gravity C, cutting the center lines of the other segments in the points C_2, C_3, C_4, C_5 and C_6; these points will be center of gravity of the segments A, B, D, etc. Fig. 1. Join the points C and C_2 by a straight line, cutting the line $a\,b$ in the point G; this point will be the common center of gravity of the two segments. Since all the segments are assumed to be equal in weight, it follows that

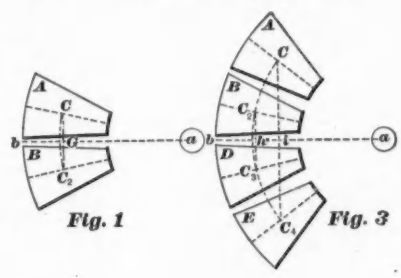


Fig. 1 Fig. 3

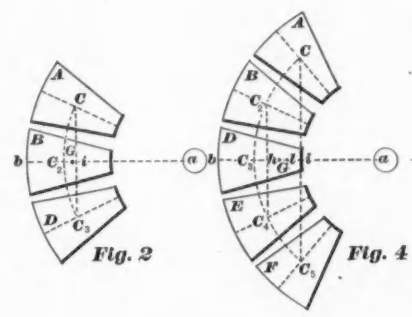


Fig. 2 Fig. 4

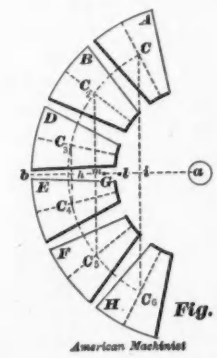


Fig. 5

American Machinist

the common center of gravity must lie midway between the points C and C_2 on a line joining these points. Fig. 2. Join the points C and C_3 by a straight line, cutting the line $a\,b$ in the point i; this point will be the center of gravity of the two segments, A and D. The center of gravity of the segment B is at the point C_2; and the weight of this segment is one-third of the whole weight of the counterbalance, therefore the common center of gravity G of the three segments will be at one-third of the distance $i\,C_2$ from i on the line $a\,b$. Fig. 3. Join the points C and C_4 by a straight line, cutting the line $a\,b$ in the point i; this point will be the center of gravity of the two segments A and E. Join the points C_2 and C_3 by a straight line, cutting the line $a\,b$ in the point h; this point will be the center of gravity of the two segments B and D. Since the sum of weights of the segments A and E is equal to the sum of the weights of the segments B and D, it follows that the common center of gravity G of all the segments must be midway between the points h and i on the line $a\,b$. Fig. 4. Join the points C and C_5 by a straight line, cutting the line $a\,b$ in the point i; this point will be the center of gravity of the two segments A and F. Join the points C_2 and C_4 by a straight line, cutting the line $a\,b$ in the point h; this point will be the center of gravity of the two segments B and E. Now, since the sum of the weights of the segments A and F is equal to the sum of the weights of the segments B and E, the center of gravity of all these four segments must be at the point l, midway between the points i and h on the line $a\,b$. Lastly, the center of gravity of the segment D is at the point C_3; and since the weight of this segment is one-fifth of the total weight of the whole counterbalance, it follows that the common center of gravity G of the five segments must be at one-fifth the distance from l between the points C_3 and l on the line $a\,b$. Fig. 5. Join the points C and C_6 by a straight line, cutting the line $a\,b$ in the point i; this point will be the center of gravity of the two segments A and H. Join the points C_2 and C_5 by a straight line, cutting the line $a\,b$ in the point m; this point will be the center of gravity of the two segments B and F; and since the weight of these two segments is equal to the weight of the two segments A and H, it follows that the center of gravity of the four segments A, H_6, B and F_5 must be at the point l, midway between the points m and i on the line $a\,b$. Join the points C_3 and C_4 by a straight line, cutting the line $a\,b$ in the point h; this point will be the center of gravity of the two segments D and E; and since the weight of these two segments is one-third of the weight of the six segments, it follows that the common center of gravity G of the whole counterbalance must be at one-third the distance from l between the points l and h on the line $a\,b$.

Business Specials

Transient Advertisements 50 cents a line for each insertion under this head. About seven words make a line. Copy should be sent to reach us not later than Saturday morning for the ensuing week's issue.

Gear Wheels, Gear Cutting. Grant; see page 782.

Forming Lathes, Mer. Mach. Tool Co., Meriden, Ct.

Milling Machs. Kempsmith Co., Milwaukee, Wis.

Marine Iron Works, Chicago (new catalog).

Patent Solicitor. J. G. D. Mack, Madison, Wis

Selden Packing for stuffing box, with or without rubber core. Randolph Brandt, 38 Cortlandt St., N.Y.

Best Presses and Dies for all sheet metal work, Ferracute Machine Company, Bridgeton, N. J.

Just issued—Catalog No. 8. Mailed Free. Clayton Air Compressor Works, 28 Cortlandt St., New York.

Wanted—Machinery to build: special, steam, mill, hydraulic. F.C. & A. E. Rowland, New Haven, Conn.

The castings I make speak for themselves. Twining Campbell, brass and aluminum founder and mfr. of machinery name plates, Paterson, N. J.

Aids to Engineers' Examinations, with Questions and Answers. Price $2, prepaid, catalog free. Theo. Audel & Co., 91 Liberty street, N. Y.

Squaring and Rotary Shears, Tinsmiths' Tools, Presses and Dies for sheet metal work, are made by the Niagara Stamping and Tool Co., Buffalo, N.Y.

Improved Duplex and Special Gear Cutters in stock and to order; Gear and Milling Cutters of all descriptions. R. M. Clough, Tolland, Conn.

A responsible concern, with shops in New England, well equipped with modern tools and force of the best mechanics obtainable, temporarily quiet on their own work, will undertake to design and build for manufacturers, special light machinery, tools, fixtures, etc., requiring the highest degree of accuracy. Address L. T. D., AM. MACHINIST.

Just published—"The Modern Machinist," by John T. Usher. Price, $2.50. A new book from cover to cover. Each of its 257 illustrations represent new devices in machine shop practice. Highly endorsed. Agents wanted in every machine shop. Send for special illustrated circular; also large scientific and practical book catalogs. Norman W. Henley & Co., 132 Nassau street, New York.

Ring Oiling Device for Bearings.

An article on chain lubricators having appeared in the AMERICAN MACHINIST of June 27th, I hereby present some observations from my own experience.

I was for some years connected with a firm who made a specialty of mill work, shafting, etc. Their hanger box was a self-oiler, constructed with an oil well, the lower part of the box having a recess in the babbitt at the bottom of the box, and two tits on lower side extending nearly to the bottom of the oil chamber, with a small hole drilled from the recess through the tits, making a connection through which the shaft, by its revolving action and by capillary attraction, would draw the oil for lubrication. Fig. 1 illustrates the lower part of this box, showing the construction by which lubrication was secured.

This device worked well in nearly all cases that came under my observation, one exception being a case where the shaft ($2\frac{7}{16}$ inches) ran only 60 revolutions per minute, and the holes were larger than usually drilled, so the action of the shaft did not draw the oil.

Later this firm did a lot of heavy shafting work for electric stations, using a box designed by the engineer employed by the purchasers. These boxes were provided with a ring-oiling device, and gave such good results that the machine company designed a ring-oiling, ball and socket box which was furnished on numerous jobs of large and high-speed electric plant shafting. Boxes were made for shafts or sleeves up to 12 inches diameter by 30 inches long, many of them running 300 revolutions per minute or more.

Some difficulty was experienced with these boxes at high speeds on account of the oil not all running back into the oil receiver, capillary attraction drawing the oil out at the joint of cap and box when it would seem that it would be impossible for oil to escape there.

On one long line of shafting that I saw, one box out of the lot gave much trouble, while the others worked all right; there seemed to be no reason why this box should give trouble, but it did, and the cause was not found. Notwithstanding the difficulties met with in this box, on the whole it gave very satisfactory results.

After the success with the larger bearings, the company designed new hangers and hanger boxes, the boxes provided with a ring-oiling device. These boxes have given good satisfaction, and a large number have been in use at the works with which I am now connected for two years giving no trouble, requiring little care and using little oil.

After leaving the employ of the machine company before mentioned, it became my duty to write specifications for a large lot of shafting from 8 inches diameter to $2\frac{7}{16}$ inches diameter, the 8-inch shafts to run at 150 revolutions per minute, and some $3\frac{1}{16}$ inches to run 300 revolutions per minute, and nearly all the shafting was to run fast. In the specifications for this shafting outfit, ring-oiling boxes were called for, and it was also required that plans be submitted showing design of hangers and boxes the contractors proposed to furnish. The contracts were let to a company in which the agent had so much confidence as not to require plans showing the design of the boxes.

The boxes came and with them trouble for all concerned. The ring-oiling device consisted of a collar of about 1 inch by $1\frac{1}{4}$ inches section for a $2\frac{15}{16}$-inch shaft bored an easy sliding fit on the shaft—some were a tight fit on the shaft. The oil chamber was small, and the lower part of the boxes were cut away and a wick-feed device supplied at the bottom, the whole oiling arrangements reducing the effective bearing surface of the box by one-half, though the boxes were not quite up to the average of good practice for length anyway. These boxes were not accepted, and then followed building over the large boxes to get a more satisfactory ring oiler and more bearing surface, and entirely new design for the small boxes. The latter operation took so long that we were obliged to put in the boxes as sent, and change when the new ones arrived. The securing of a box which would be satisfactory to us was a tedious operation. The manufacturers had their old patterns and their own ideas about hanger boxes. In their first sample box they ignored our directions and made several that would not hold oil, but finally after about six attempts at a compromise made a box that would hold oil, and worked well.

The principal difficulty which had to be overcome was the return of the oil carried up by the rings to the oil chamber without leakage, any drop of oil from the box being objectionable, besides wasting oil and requiring attention to keep oil chambers supplied. These boxes are now running well, require very little attention, and are economical in use of oil.

Among the requirements of a good ring-oiling box is such a construction that oil will not run out on the shaft. One successful means used to prevent this is a wiper of babbitt metal in a recess at the end of the box that will wipe the oil off the shaft as it follows the shaft out of the bearing and before it gets beyond the edge of the oil receiver. The wiper is shown at *A*, Fig. 2. The wiper is held against the shaft by a spring to which it is secured, and the spring is secured to the side of the oil receiver. This wiper adds to the length of the box, and is in that respect objectionable, especially where room on the shaft is valuable. The mistake is made in some boxes of using a wiper too short to stop all the oil, and of not giving room enough on the sides of the wiper in others.

Another source of much trouble is to prevent loss of oil at joint between box and cap. The oil receiver must be made to catch this, or the construction of the box must be such that oil cannot get to this joint, as usually if the oil gets at this joint it will run through by capillary attraction, helped by any movement the shaft may impart to the cap if it is not fastened down solid, as often it cannot be when starting new boxes.

It is well to so construct the box that dust will not have access to the oil chamber.

The distribution of oil carried up by the rings can be effected by oil channels cut in the babbitt of box and cap, this being especially necessary in long and large bearings, as usually only two rings are used. Also the amount of oil carried up can be regulated by the size of section and shape of ring used, being larger as more oil is wanted, and larger as the shaft is to run slow and have a heavier load. Oil channels to aid in distribution of oil are shown at *B*, Fig. 2.

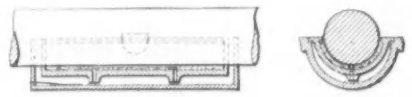


Fig. 1

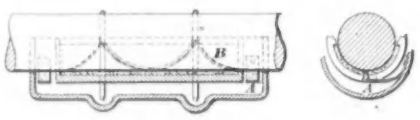


Fig. 2

Fig. 3

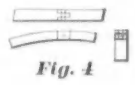


Fig. 4

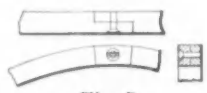
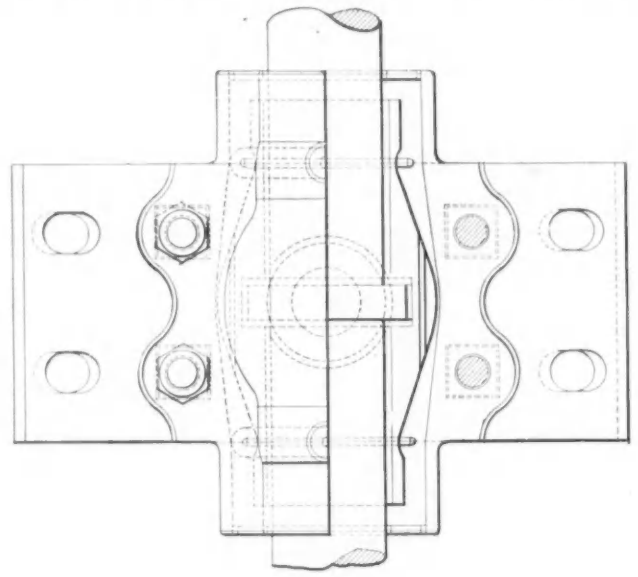
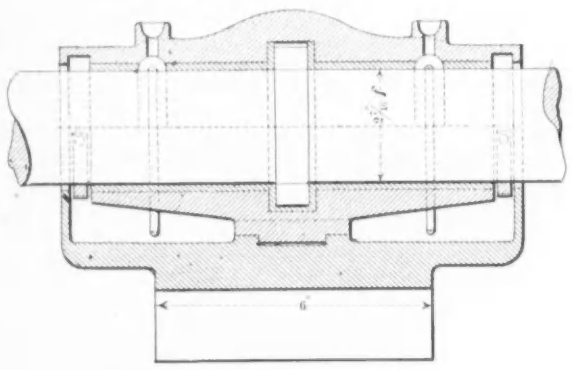


Fig. 5





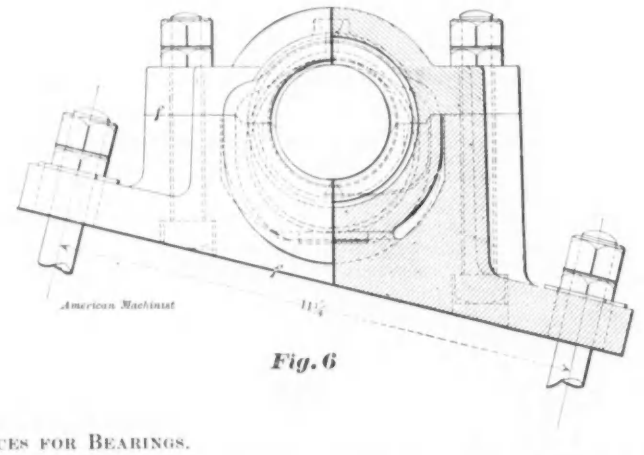


Fig. 6

RING-OILING DEVICES FOR BEARINGS.

SCREW PITCH GAGE.

With the ring-oiling box the ring does not touch the bottom of the oil chamber, and as it is smooth does not agitate the oil to an extent to prevent the heavy particles settling to the bottom and staying there.

The difficulty of the rings catching on some projection and stopping may be prevented by suitable construction; either have nothing on the ring to catch or have nothing in the way that can stop the ring. One way is to notch the ends of the rings as in Fig. 3, or they may be joined as in Fig. 4. For large boxes they may be made in halves, and the joint made as in Fig. 5.

A good ring for hanger boxes for a 4-inch shaft can be made of half-round spring steel wire $\frac{3}{16}$-inch diameter of section, they must be bent to a true circle, and must be of good stock, so as to be capable of being put onto the shaft and into the box without taking off couplings on the end of shaft or pulleys that may be on the shaft. This ring is shown in Fig. 3.

A good point in favor of the ring box is that when the belts have a tendency to lift the shaft out of the boxes the ring oiler still supplies the bearing with oil, even if there be $\frac{1}{4}$-inch play in the box that would permit the shaft to be lifted clear of a wick-feed device, or a suction-feed device.

In support of the ring-oiling box I would call attention to its very successful use on dynamos. This is a place where a reliable oiling device is a necessity, and the ring-oiling box is used with marked success.

If Mr. Smith has an opportunity, I would like him to examine the bearings of a Westinghouse or Edison dynamo. I think he will see a very satisfactory application of the ring-oiling device.

Mr. Smith makes some very pertinent statements regarding the disadvantages of the chain and ring-oiling devices, but does not point out their good qualities. His experience seems to have been with chain oilers mostly, while mine has been with ring oilers.

A ring-oiling box, designed by myself for a special purpose, is shown in detail in Fig. 6. This box was used to carry a short $2\frac{7}{16}$-inch shaft having an overhanging pulley, running at 600 revolutions per minute, and carrying at times about 20 horse-power; this box has done well in this case, and has been used at various speeds as low as 20 revolutions per minute, and has given excellent satisfaction. It is not without faults, there is not quite room enough each side of wiper in the ends, and I think it would in some cases leak oil at the joint of box and cap though it has not done this much so far.

Ring-oiling boxes properly constructed for the work they have to do can be depended on for a copious supply of oil without waste, and require very little attention. A box can reasonably be depended on to run six months without refilling, if it is not overloaded. I am aware that some other self-feed devices will do this, but I have more confidence in the ring oiler.

M. A. CHINE.

Screw Pitch Gage.

We present herewith an engraving of a screw pitch gage of improved form, which is adapted to use in nuts as well as upon bolts, the finer pitches being arranged together at one end upon blades made narrower so that they can be inserted in small nuts. At one end are all pitches from 9 to 20 inclusive, and at the other all pitches of even numbers from 22 to 40 inclusive, and the numbers are stamped upon the frame as well as upon the blades, in such a manner as to enable the user to locate and select any desired blade at a glance. It is made by Brown & Sharpe Mfg. Co., Providence, R. I.

Death of Herman Winter.

Herman Winter died in Brooklyn September 3d. Mr. Winter was born in Prussia in 1828, coming to this country with his parents when two years old. After leaving school he entered the Morgan Iron Works in this city. Mr. Winter made rapid advances, and when but 22 years of age he had become a valued assistant to Mr. Morgan, and is credited with having persuaded the proprietor into the application of the screw propeller to a line of steamers then running to the Gulf of Mexico. Mr. Winter went to Europe to superintend the erection of en-

gines from this country upon the Danube, and remained as superintendent of the Danube Construction Company until nearly the date of the civil war. Mr. Winter superintended the fitting out of many cruisers and transports for the government, and became employed in the designing and construction of the ironclads. He furnished plans for one of the first Italian cruisers, and designed the 'Aransas," the first twin-screw steamer launched in the United States. He also built the "Wyanoke," of the Old Dominion line, and several steamers for the Metropolitan freight line between New York and Boston. In 1885 he was appointed by President Cleveland with William C. Whitney and Commodore Belknap to inquire into the manner in which the contracts for the "Chicago" and several other ships had been fulfilled. He was the New York inspector for Lloyds. He made numerous inventions, among which were the Winter cut-off and a wharf drop in general use along the water front. Mr. Winter left a son and several daughters and a large estate.

We think of New Zealand as a spot on the outermost edge or tag-end of civilization, but a few facts and figures concerning that country will show that it is much nearer the van than the tag-end. It is only 55 years since the sovereignty of the Queen was proclaimed over the island of New Zealand and cannibal feasts were held near the site of what is now an important city. To-day it is inhabited by 728,000 persons, of whom all but 50,000 are whites. It is crossed from end to end with railways and telegraphs, and the income of its population is over $135,000,000 a year, half of which comes from farms and mines. There are $90,000,000 of money on deposit in the colony, and the value of manufactures produced in the year amounts to $45,000,000. New Zealand has 1,200 churches and chapels; 77 per cent. of the population can read and write. In the consumption of drink New Zealand is the eleventh in the list, coming after Switzerland, and the sixteenth in the consumption of tobacco, coming after France. In the last fifty years gold to the value of $245,000,000 has been sent out of the country. The average total wealth at the end of 1894 was estimated at $750,000,000; the public debts at $200,000,000, of which $75,000,000 were spent in railways, and 3 per cent. in the interest. The wealth of the United Kingdom is $1,235 per head, and that of New Zealand comes next, with $1,160. Woman suffrage has lately been introduced and is said to have worked very well. There is an arbitration law giving power to settle trade disputes to a council of three, one appointed by the trades unions, one by the employers of labor, and the third by the governor and council of the colony, with a judge of the Supreme Court as president. In taxation the advanced principle of gradation has been adopted—a principle based on the doctrine that people should pay in proportion to their means. The tax is divided into land and income tax, the former being aimed at speculators who hold large tracts of vacant and idle land for a rise.

At the present writing, the fastest war vessel afloat is owned by France. The seagoing torpedo boat, the "Forban," recently tried, built under a contract for a speed of twenty-nine to thirty knots, easily made 30.2 knots, or 34.7 land miles per hour, despite a heavy sea and high wind, which shows her to be faster than any other ship in the world. The "Forban" is 144 feet long, 13 feet 6 inches beam and draws 8 feet of water. She has two screws and her engines are capable of developing 3,200 horse-power. She carries two 37 millimeter (1.45 inches) quick-firing guns, and two torpedo tubes above water.

Mr. John A. McGregor, who two years ago resigned the position of assistant superintendent of the Brown & Sharpe Mfg. Co.'s shops to become a member of the firm of Edwin Harrington, Son & Co., Philadelphia, Pa., and superintendent of their shops, has resigned this last named position, and on September 1st became general superintendent of the shops of the Morse Twist Drill and Machine Co., at New Bedford, Mass.

Mr. Egbert P. Watson, of *The Engineer*, has purchased Mr. B. H. Warren's interest in that paper, and it is now again published by Egbert P. Watson & Son, instead of by the Watson-Warren Co., as heretofore.

By direction of the Executive Committee, the date for holding the Annual Convention of the National Association of Manufacturers, at Chicago, Ill., has been changed to November 19, 1895.

NEW CATALOGS.

There are three sizes of Standard Catalogs, 9" × 12", 6" × 9" and 4½" × 6". We recommend the 6" × 9" size for machinery catalogs. When they must be larger or smaller, one of the other standard sizes should be adopted if possible.

The Hunt Air Brake Co., Pittsburg, Pa., send us their "Instruction Book" for the maintenance and handling of the Hunt air-brake system, which is especially adapted to trolley and other street car service. The brake uses compressed air which is obtained from a compressor driven by an eccentric attached to the axle of the car or by an independent motor driven by electricity, as may be preferred, and it is claimed that the use of the brake greatly lessens the liability to accident, and that it is economical.

The Babcock & Wilcox Co., 29 Cortlandt street, New York have issued two new publications, which illustrate very forcibly the well known fact that competition and rivalry between the various boiler manufacturers is rather more keen perhaps than in any other line of business pertaining to mechanical engineering. One of these publications is called "Facts," and is devoted mainly to showing up the defects of competing boilers, their defects and shortcomings being in many cases, we are bound to say, very clearly shown, both by illustration and text. The other publication is called "Steam at High Pressure," and shows how the Babcock & Wilcox boiler is adapted to making and carrying steam at unusually high pressure. Part of this book is devoted to the Centennial exhibits of boilers with sketches of the boilers shown at that time and deductions drawn from subsequent experience with them. Elegant halftone and other engravings are used in these books, and they will be found of unusual interest to every one who has to do with steam plants. They are bound in ornamented stiff covers, and are 7½"x10¾".

MANUFACTURES

The Dayton Furnace and Foundry Co. has been incorporated at Dayton, Ohio, with a capital of $100,000.

The Peckover Saw Co. has recently been organized at Philadelphia, Pa., by Robert E. Patterson and others.

The McClure-Mabie Lumber Co., of Roaring Creek, W. Va., has been organized by W. H. Mabie and others.

The Wabash (Ind.) Bridge and Iron Works has been organized with $30 000 capital. John B. Latcham is president.

The Dake Engine Co., of Grand Haven, Mich., has been formed with $60,000 capital, by J. P. Armstead and others.

The Superior Foundry Co., of Little Falls, N. Y., has been organized by Victor and F. H. Burrows, with $20,000 capital.

The International Electric Co., of St. Louis, Mo., has been organized with $15,000 capital by Geo. S. De Lisle and H. B. Russell.

At Washington, D. C., the Union Automatic Co. has been organized with a capital stock of $60,000. B. H. Warner is president.

The Benjamin Iron and Steel Co. has been organized at Buffalo, N. Y., with a capital of $100,000. Cornelius J. Kane is secretary.

The Vagan & Bader Co., of Austin, Texas has been formed to manufacture firemen's smoke protectors, by W. C. Vagan and others.

A company has been organized at Yorkville, S. C., to erect a cotton-mill, with a capital of $100,000. W. R. Carroll is interested.

The Wesson-Nivison Co., of Cortland, N. Y., has been organized to manufacture bicycles, by W. O. Nivison and Frank C. Moore.

At Chicago, Ill., the Potter & Hollis Foundry Co. has been incorporated, with a capital stock of $10,000 by Edw. C. Potter and Michael Schmidt.

The Bodsman Lumber Co., of Houston, Texas, has been incorporated by J. F. Bodsman, Ross Gamble and others. They will shortly erect a mill.

The New Orleans (La.) Cotton Mfg. Co. has been incorporated with a capital of $100,000. The officers are Ernest V. Reiss, president; Leo P. Newman, vice-president, and A. L. Center, secretary and treasurer.

The American Tin Plate Co., of Elwood, Ind., are making extensive additions to their already large plant, and will be able to supply next year about five times their present output. They are adding quite a number of new machines to their repair shops, among which is a large upright drill made by the Lodge & Davis Machine Tool Co., of Cincinnati, Ohio.

A user of the Buffalo Forge Co.'s system of force blast, Schoellkopf & Co., of Buffalo, write that they find this system very effective in the prevention of smoke, and say: In fact its service is so complete in this respect that we can find no excuse for our neighbors' troubling us with their chimneys, and we are contemplating the entry of a formal request to the proper authorities for the abatement of this nuisance as altogether unnecessary.

M. C. Henley, of Richmond, Ind., identified for many years with the roller skate and lawn mower business, is now engaging in the manufacture of bicycles on an extensive scale, and proposes to turn out something like 7,000 wheels annually. He will operate as the Henley Bicycle Works. Orders have been placed with The Lodge & Davis Machine Tool Co., of Cincinnati, Ohio, for such of their machines as are particularly adapted to the manufacture of bicycle parts.

The Phosphor Bronze Smelting Co., 220 Washington avenue, Philadelphia, Pa., who are well-known makers of phosphor bronze for machinery bearings, announce they have purchased the processes and exclusive rights for the manufacture of "delta metal" in the United States, and are prepared to furnish this in castings, stampings, forgings, bolts, rods, etc. This material has been successfully used in England and on the continent, and is said to possess a strength equal to mild steel with great rigidity, toughness and resistance to corrosion, and is especially adapted for propellers, blades and shafts, heavy and light gearing, drop forgings, valve stems and other parts of machinery.

Machinists' Supplies and Iron.

NEW YORK, September 7, 1895.

Iron—American Pig—We quote standard Northern brands, $14 for No. 1; $13 for No. 2; $12.75 for No. 2 Plain, and $12.50 for Gray Forge. Southern brands, $14 for No. 1; $13.50 to $13.75 for No. 2; $13 to $13.50 for No. 3; $13.50 to $14 for No. 1 soft; $13 to $13.50 for No. 2 soft; and Foundry No. 4, $12.50 to $12.75.

Antimony—The market is unchanged, business is fair, and prices are steady. Cookson's is quoted at 8c. to 8¼c.; Hallett's, 7⅛c. to 7½c.; Japanese, 7c.

Lard Oil—Prime City is quoted at 50c. to 51c.

Copper—The market is steady and business is moderate without any great activity in sight. Lake Copper has been sold at 12⅛c. to 12¼c., and Casting Copper is held at 11⅝c. to 11¾c. for good brands.

Lead—Business has been transacted at 3.45c. for near futures, but at the close of the market this was refused. The general quotations are 3.50c. to 3.52½c.

Spelter—The prices have weakened; good Western brands can be bought at 4.15c. to 4.17½c. Dealings have been moderate.

Tin—Considerable tin has been delivered on September contracts. Consumers demand has been light; 14.25c. is quoted.

✲WANTED✲

"Situation and Help" Advertisements only inserted under this head. Rate 30 cents a line for each insertion. About seven words make a line. The Cash and Copy should be sent to reach us not later than Saturday morning for the ensuing week's issue. Answers addressed to our care will be forwarded.

TO SUBSCRIBERS.

On and after July 4th this paper will give two free insertions under this heading to those in want of positions. The advertisement to occupy a space of not more than five lines. Additional space or insertions must be paid for in advance at regular rates.

Wanted—Bright, active machinists to canvass for subscription to AMERICAN MACHINIST, liberal commission. Address, with refs., Subscription Dep't, AMERICAN MACHINIST, 203 Broadway, N. Y.

Draftsman, experienced in water pumps and ice machines, wants position. BOX 107, AM. MACH.

Foreman patternmaker, thor. in all its branches, desires to make a change. Box 95, AM. MACH.

Position wanted by machinist, sober and reliable. Address G., care AMERICAN MACHINIST.

First-class, up-to-date tool and die maker wants position. BOX 105, AMERICAN MACHINIST.

Wanted—Situation as general foreman or superintendent of high-speed engine shop; at present supt. of shop. "D. A.," care AM. MACHINIST.

Wanted—Position as superintendent, foundry and machine business, 20 years' exp. in general work. Address Box 97, AMERICAN MACHINIST.

Wanted—Position as superintendent of machine shop, can handle any class of work, and any number of men. Address C. L. W., AM. MACHINIST.

Wanted—Mechanical draftsmen, North and West, with evenings free; state present position. Edwin Guthrie, Corcoran Building, Washington, D. C.

Mechanical draftsman wants position (22), technical education, 6 years' office and shop exp. on eng., boilers, print'g mach'y. Box 104, AM. MACH.

Experienced Designer Wanted—Familiar with all classes of bookbinders' and paper-cutting machinery, for the West. Address, stating all particulars, "A," care of AMERICAN MACHINIST.

Wanted—A position by a young man with technical education as draftsman, assistant to master mechanic, or in construction of electrical machinery. H. W., care AMERICAN MACHINIST.

Wanted—A Corliss engine draftsman; must be a specialist and capable of leading; also a draftsman who is capable of training a small Episcopal choir. Address Box 100, AMERICAN MACHINIST.

Wanted—A first-class patternmaker, one familiar with heavy saw-mill, woodworking and general machinery; state age, experience and salary expected. Box 101, AMERICAN MACHINIST.

A mechanical engineer wants to make a change. Superintendent or master mechanic. 25 years' experience. Unquestionable proof of ability and character. Address A. L. Y., AMERICAN MACHINIST.

Any manufacturer of machine tools or special machinery desiring direct representation in New York City can learn something to his advantage by addressing Box 106, care of AMERICAN MACHINIST.

A draftsman having experience in engine work, and graduate of technical school, desires position as draftsman with a reliable firm. Best of references given. Address Technique, AM. MACHINIST.

Draftsman, age 26, with 8 years' machine shop and 2½ years' drawing-office experience, having good technical education, desires position where practical knowledge and judgment will be a requisite advantage. Box 99, AMERICAN MACHINIST.

Wanted—Two or three good draftsmen, men who are accustomed to making machine drawings, and who have had a general shop experience on drafting work. Address A. C. Mfg. Co., care of AMERICAN MACHINIST.

Mechanical engineer and draftsman, a young man 28, having technical education, a thorough knowledge of modern shop methods and extensive experience with leading concerns, is open for engagement. Address Box 103, AM. MACHINIST.

Wanted—To take charge of shop manufacturing gas engines, by active machinist and draftsman, experience with single and double cylinder engines, can work men to advantage. Address Box 98, AMERICAN MACHINIST.

Wanted—Foremanship by a competent man on drop forgings and machine blacksmith work; a hustler with several years' experience in charge of tool room and smith shop. Address M. Y., care of AMERICAN MACHINIST.

Wanted—A first-class draftsman; one having experience in the drawing room of an electrical manufacturing company preferred; give age, references, experience, nationality and education. Send samples of work and state salary expected. Fort Wayne Electric Corporation, Fort Wayne, Ind.

Wanted—A superintendent to take charge of a brass factory who is thoroughly experienced in the mixing of metals and finishing of valves, cocks, etc., for steam and water service; for a good man who knows his business and can handle men there is a good position. Address Box 87, AMERICAN MACHINIST.

Wanted—A person who has had experience in handling large bodies of help, and, preferably, one familiar with the forging and tempering of tool steel, is wanted by one of the largest manufacturing companies in the country; state length of experience and where obtained; also amount salary required and furnish references. Address Box 102, AMERICAN MACHINIST.

Advertiser has been otherwise engaged of late and would like to correspond with parties in need of a foreman or man to fill other responsible position, as I wish to secure position in such capacity on or before October 1st; can furnish first-class references as to ability, etc.; or correspondents can refer to columns of the "A.M." and other journals, and to my recently published book, "The Modern Machinist." Address John T. Usher, 498 Third Avenue, New York City.

✢ MISCELLANEOUS WANTS ✢

Advertisements will be inserted under this head at 35 cents per line, each insertion. Copy should be sent to reach us not later than Saturday morning for the ensuing week's issue. Answers addressed to our care will be forwarded.

Cheap 2d hd lathes & planers. S.M.York,Clev'd,O.

Calipers & Gauges. F. A. Welles, Milwaukee, Wis.

Light and fine mach'y to order; models and electrical work specialty. E. O. Chase, Newark, N. J.

For Sale—A first-class key-seater, new. **Address Mitts & Merrill, 913 Tilden St., Saginaw, Mich.**

Best and cheapest Bolt Header made by C. H. Baush & Sons, Holyoke, Mass.

Wanted—A purchaser for a good key-seater, by **Mitts & Merrill, 913 Tilden Street, Saginaw, Mich.**

Wanted—Good 2d-hand air compressor; give full particulars. Address Armour & Co., Chicago, Ill.

Pat's obt'd; no atty's fee until allowed; exp't service. Thurman & Silvius, mech. engs., Ind'polis, Ind.

Wanted—To correspond with any one in need of a first-class key-seater, Address Mitts & Merrill, No 913 Tilden Street, Saginaw, Mich.

For Sale Cheap—100,000-pound Riehle testing machine, in good order. Address Alfred Box & Co., Front and Poplar streets, Philadelphia, Pa.

For Sale—Tabor duplex automatic molding machine with 18-inch cylinder; molds two flasks 12x15, or one flask 15x24 inches; perfect condition. Box 94, AMERICAN MACHINIST.

For Rent—A small machine shop 10 horse engine with or without blacksmith and wood shops; work for 2 men furnished by owner; good location for job shop. Address Lock Box 6, Fultonville, N. Y.

For sale—Two 22" Plain Hamilton Drill Presses, one 26" back gear and power-feed Hamilton Drill Press, one 30" Springfield Tool Grinder. These are new machines and will be sold cheap for cash. Dietz, Schumacher & Co., Cincinnati, Ohio.

For Sale—A foundry and machine shop together, with steam engine and boiler, also shafting in the same; plant is located 30 miles from Chicago on the Outer Belt Line which connects with all railroads entering Chicago. Address J. P., AMERICAN MACHINIST.

Wanted—An Idea. Who can think of some simple thing to patent? Protect your ideas; they may bring you wealth. Write John Wedderburn & Co., Patent Attorneys, Washington, D. C., for their $1,800 prize offer.

STEEL CASTINGS OF EVERY DESCRIPTION. MADE FROM BEST OPEN HEARTH STEEL. Send for Estimates. THE JOHNSON COMPANY, Johnstown, Pa.

THE AMBITIOUS MACHINIST

Should Study the Theory of His Trade.

The International Correspondence Schools, Scranton, Pa., Provide for all Classes of Mechanics Thorough Courses of Home Instruction, Moderate in Price, which they can begin if Able to Read and Write, and can Complete, without Loss of Time from Work, if they are Willing to Study.

Machinists, Patternmakers, etc., who will study and obtain a knowledge of Mathematics, Mechanics and **Mechanical Drawing,** will be qualified to take advantage of the opportunities for advancement which continually present themselves to intelligent mechanics. A Machinist thoroughly equipped with a knowledge of the theory of his trade is required to superintend some specially important work, or a **Foreman** is wanted. The man who is educated is the man selected; he always occupies the most responsible position and has the best-paying job.

Machine Shop Foremen cannot expect to become Superintendents without such a knowledge of the theory of mechanics as will qualify them to supervise the construction of all classes of machinery. A knowledge of **Mechanical Drawing** is indispensable to **all** foremen of mechanical establishments.

Draughtsmen need Guidance in their studies; otherwise they are likely to meet with failure in their efforts to qualify for **Responsible Positions in the Engineering Profession. Superintendents** must know more than Foremen and must be well up in Mechanics, Kinematics, etc., or be often compelled to defer to the superior knowledge of their subordinates—a harmful and humiliating necessity.

OUR METHOD. Our Courses commence with Arithmetic, **so that to enroll it is only necessary to know how to read and write.** Students are furnished with Instruction Papers, WHICH ARE ALL THE BOOKS THEY NEED, and with Question Papers, to bring out what they have learned. The answers are sent us for examination and correction. When they need aid students write to us, on blanks which we furnish. Such requests are answered promptly and fully. The Instruction Papers are written by our own Instructors, who know from experience just what workingmen need to learn in order to qualify for advancement, and are freely illustrated.

SUITS WORKINGMEN AND BUSY PEOPLE. A Scholarship entitles the holder to tuition until he is proficient, no matter how long it may take. Students lose no time or money going to school; can interrupt studies; can carry Instructions with them and can change residences. Each student is taught separately, and his studies are so arranged that he must do thorough work. Prices for tuition are low. Payments may be made by installments. Scholarships are not forfeited upon failure to pay promptly.

SPLENDID RESULTS. We can teach any who will study. Backward students cannot exhaust our patience, and our strongest endorsers are those with whom we have had most trouble. Many have learned Arithmetic and Algebra who were unable to do so by any other method. We teach with great success all subjects advertised. Our method of teaching Drawing is superior to any other of which we know. In a few months students learn to make neat and well-lettered drawings. We can teach any man to draw.

If you desire to learn or review the theory of your trade, we offer you, in The International Correspondence Schools, 27 technical Courses, including, Mechanics; Mechanical Drawing; Electricity; Steam Engineering (Stationary, Locomotive or Marine); Architecture; Architectural Drawing; Civil Engineering; Bridge Engineering; Railroad Engineering; Hydraulic Engineering; Municipal Engineering; Plumbing and Heating; Coal and Metal Mining; Prospecting; English Branches. 8,000 students, in all parts of the world, are taking advantage of these opportunities, and all who study make good progress.

For FREE Circular of Information, giving full particulars, Address

THE INTERNATIONAL CORRESPONDENCE SCHOOLS, Scranton, Pa.

BUFFALO VENTILATING FANS — ELECTRIC, STEAM AND PULLEY TYPES, GREATEST AIR VOLUME, LEAST POWER. Chicago Office, 22 and 24 West Randolph Street. BUFFALO FORGE CO. BUFFALO, N.Y. U.S.A.

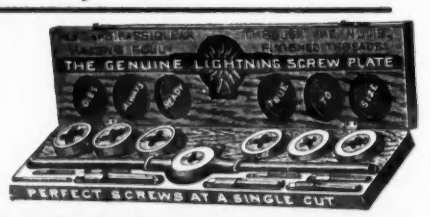
BUFFALO LUMBER DRY KILNS. PROGRESSIVE AND APARTMENT TYPES. BUFFALO FORGE CO. BUFFALO, N.Y. U.S.A.

Genuine Lightning Screw Plates,

Taps, Dies, Reamers, Green River Screw Plates, Bolt Cutters, Drilling Machines, etc.

SEND FOR CATALOGUE.

WILEY & RUSSELL MFG. CO., GREENFIELD, MASS., U. S. A.



Crescent Steel Co. **STEEL** of remarkable purity and strength for costly tools and dies.

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NO BETTER MADE ANYWHERE.

GRANT GEARS

Ready Made Iron Gears.
Ready Made Brass Gears.
Gears Made to Order.
Gear Cutting.
1895 Gear Book, Free.
Treatise on Gears, $1.00.
GEORGE B. GRANT,
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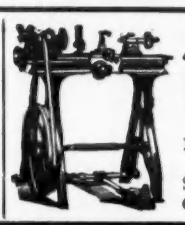
and 125 South 11th St.,
Philadelphia, Pa.,
and 86 Seneca St.,
Cleveland Ohio.



Star Foot-power Screw Cutting Automatic Cross Feed Lathes

9 and 12 inch Swing.

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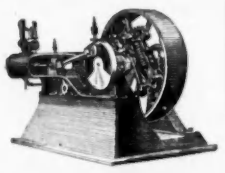

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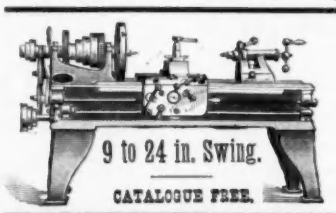

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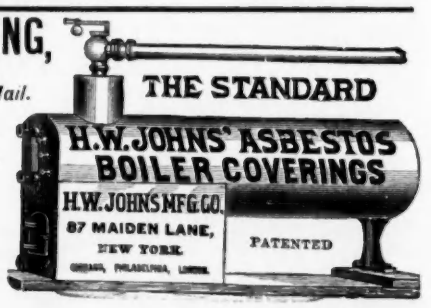

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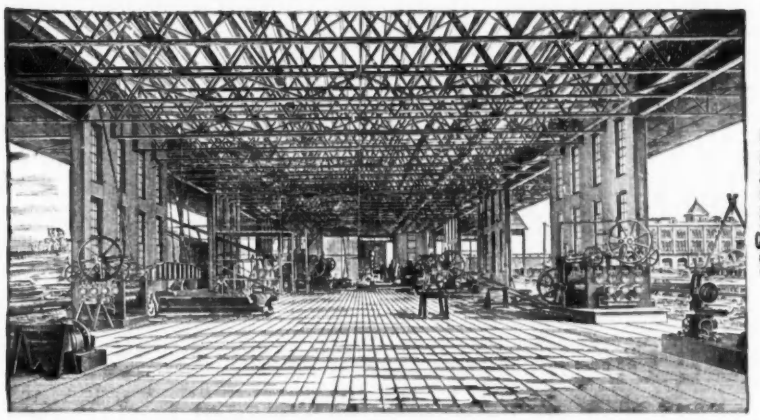

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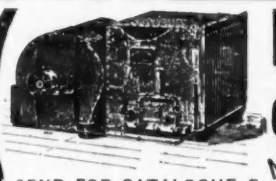

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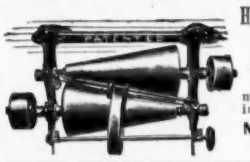

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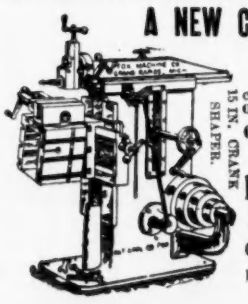

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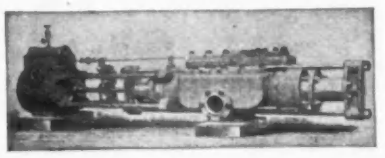

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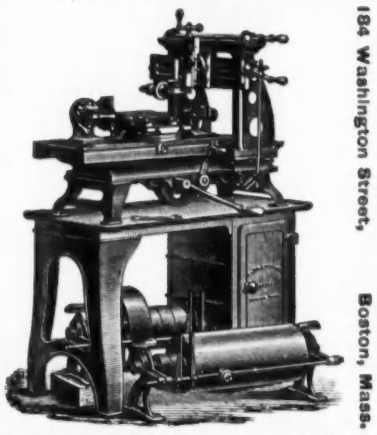

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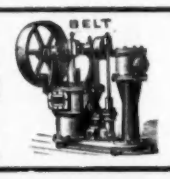

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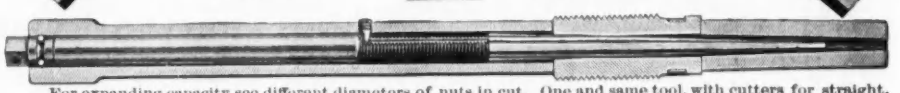

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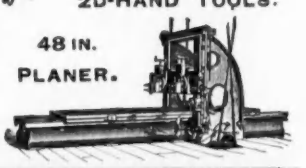

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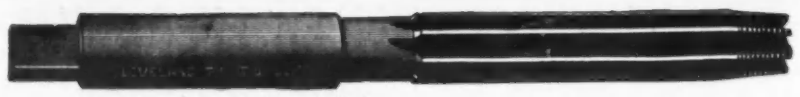

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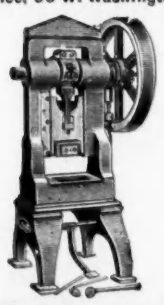

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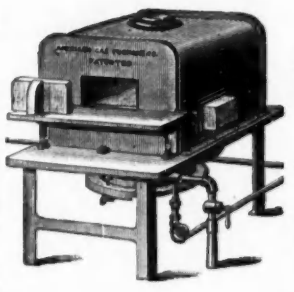

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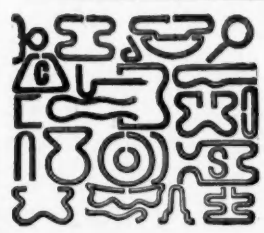

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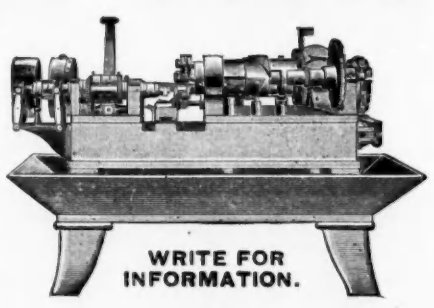

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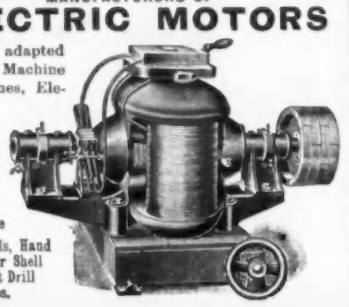

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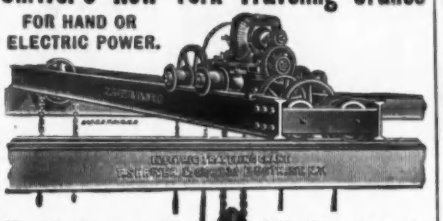

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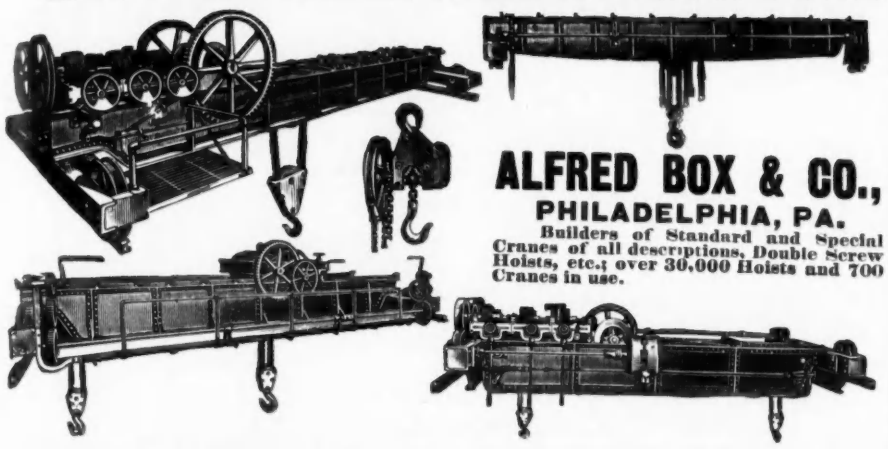

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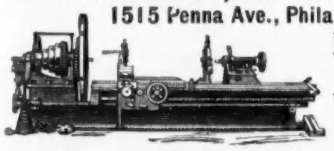

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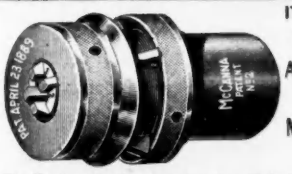

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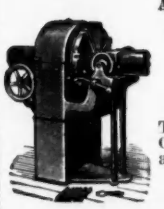

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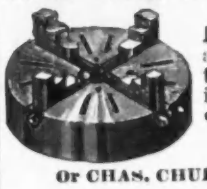

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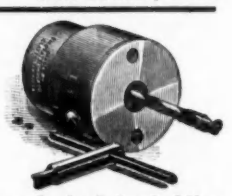

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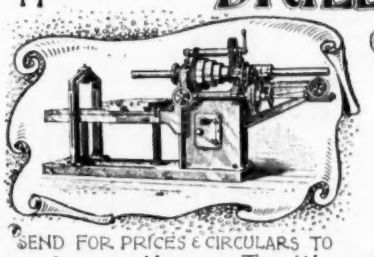

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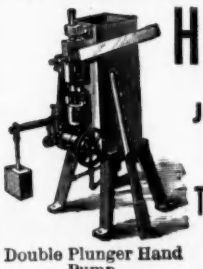

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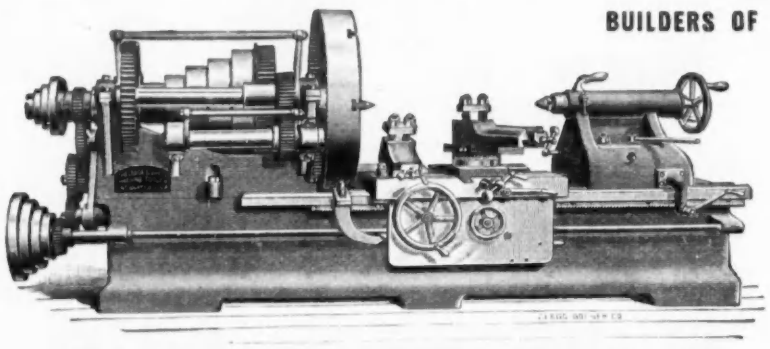

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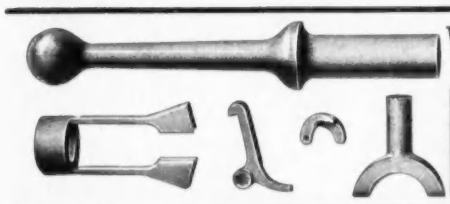

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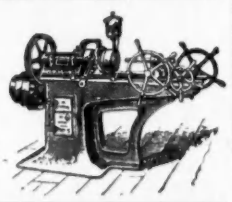

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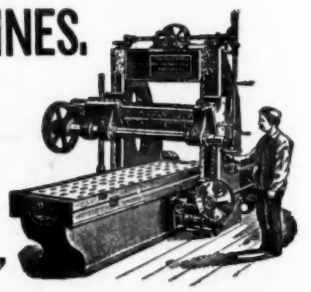

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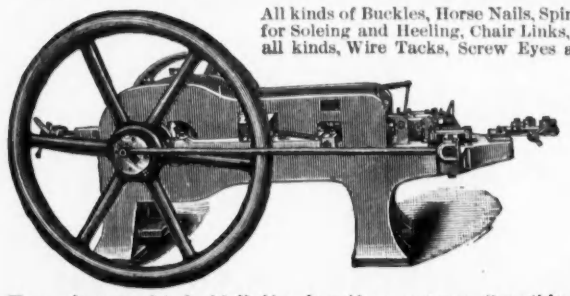

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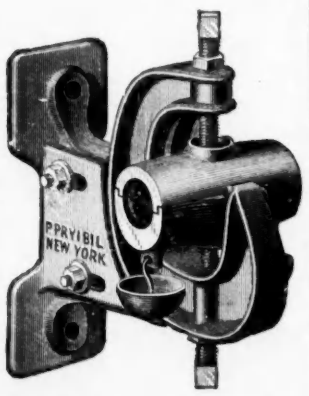

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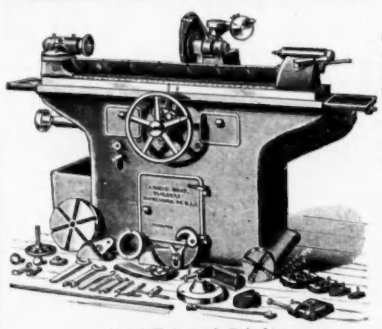

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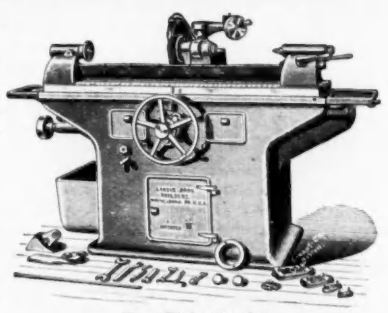

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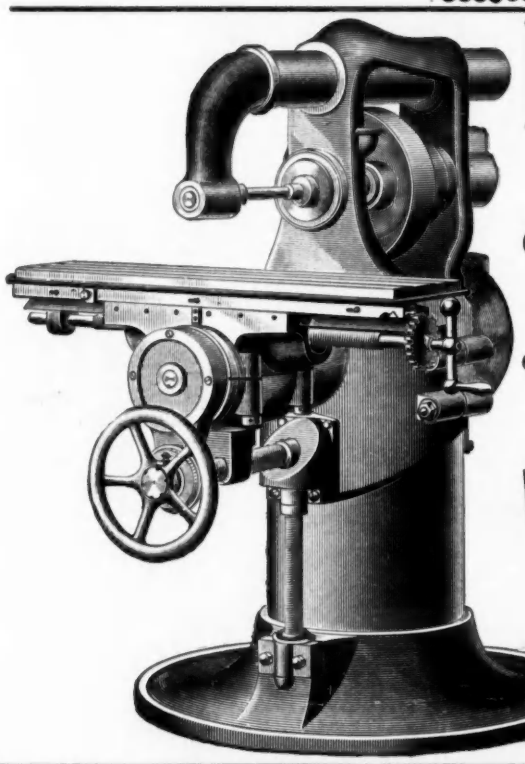

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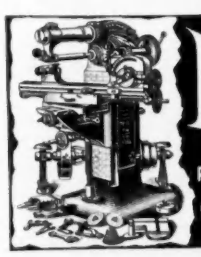

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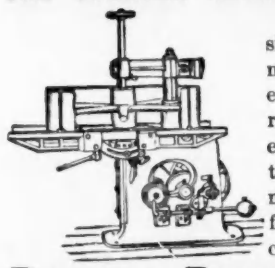

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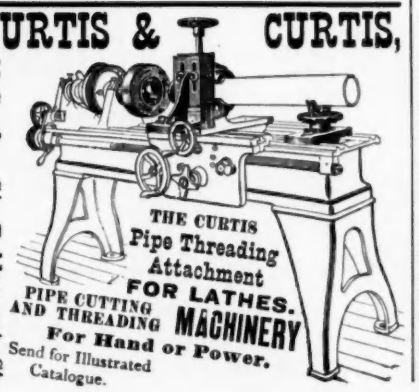

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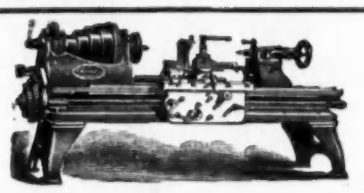

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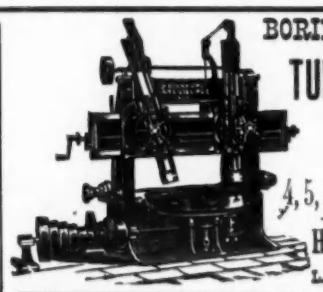

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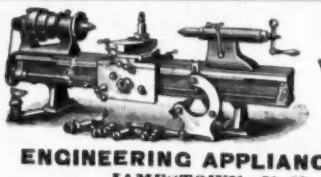

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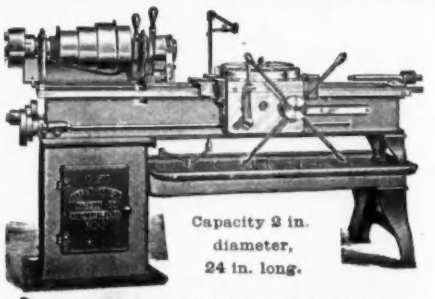

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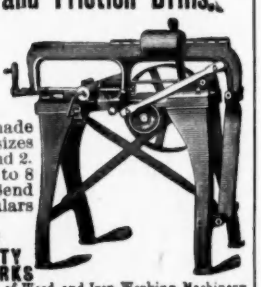

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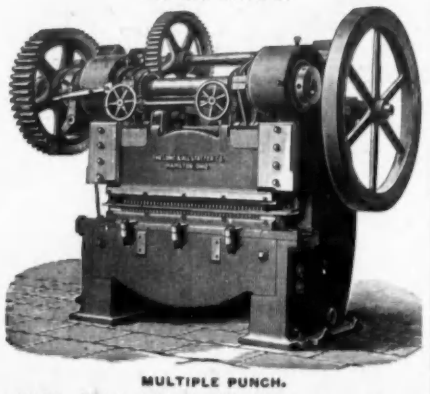

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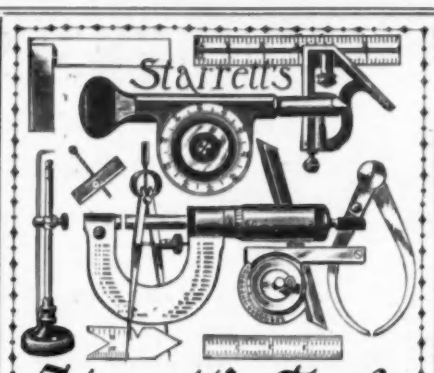

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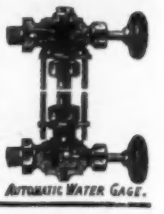

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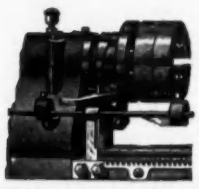

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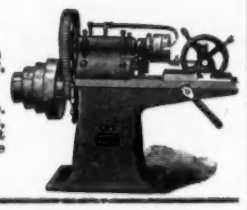

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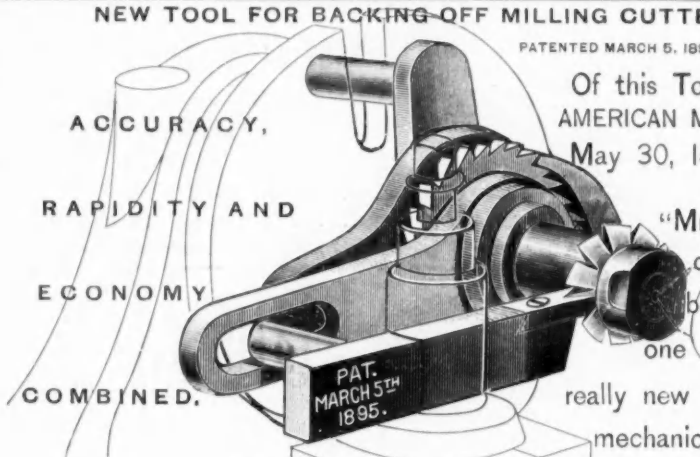

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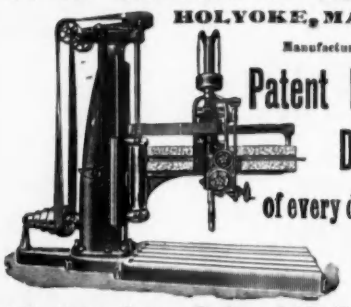

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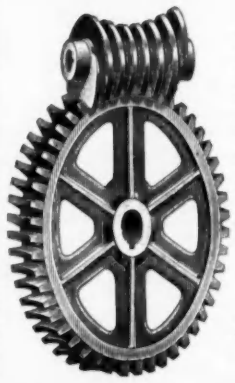

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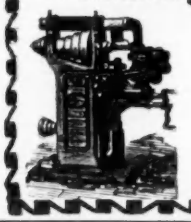

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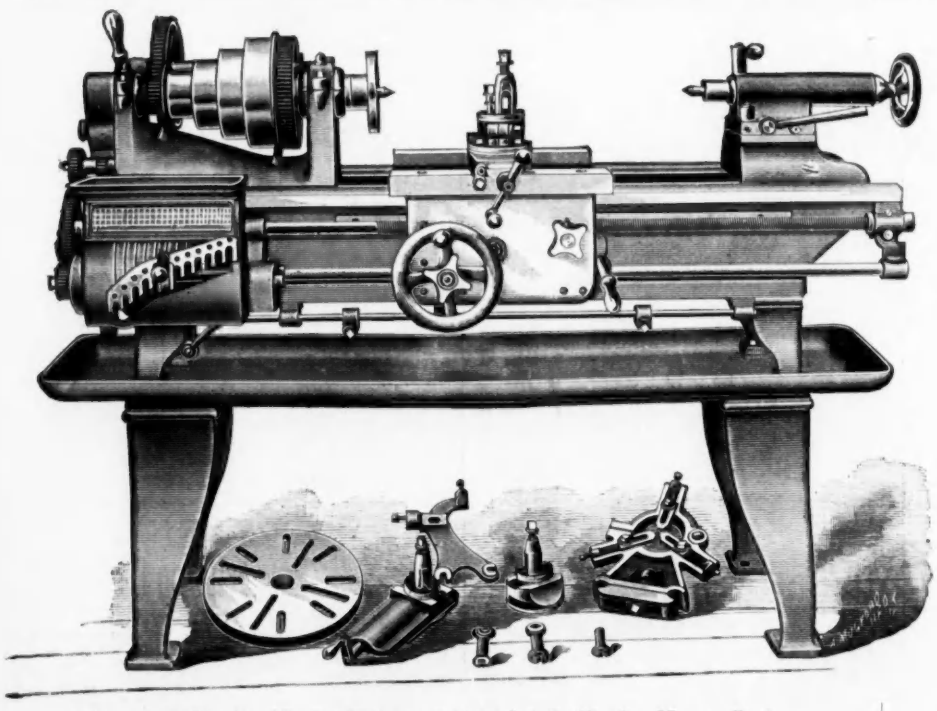

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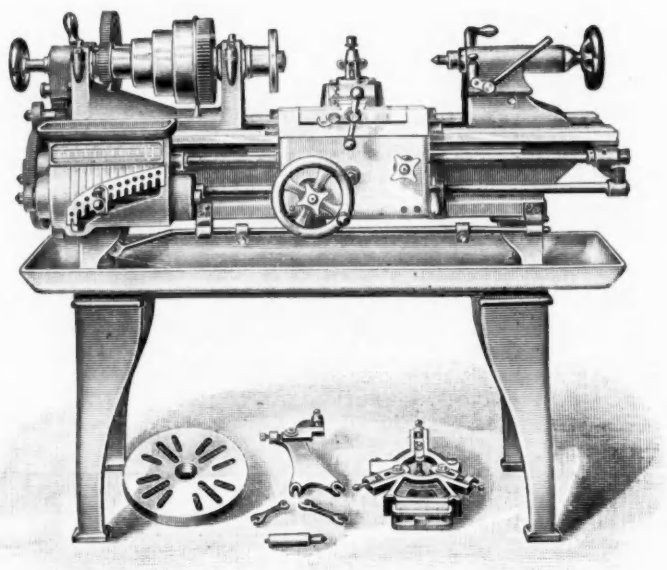

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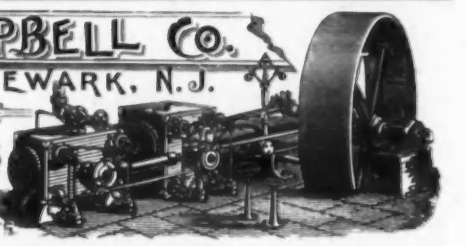

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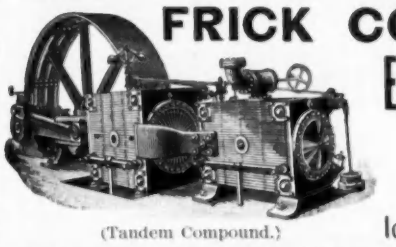

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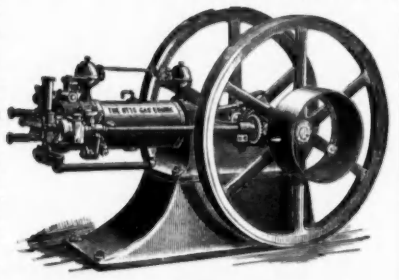

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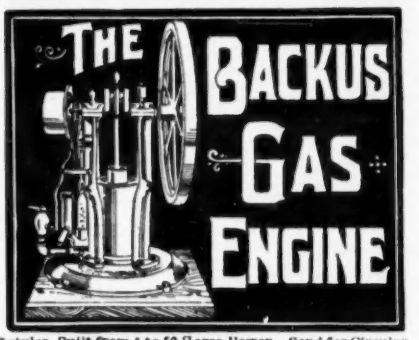

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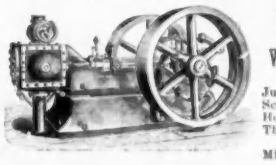

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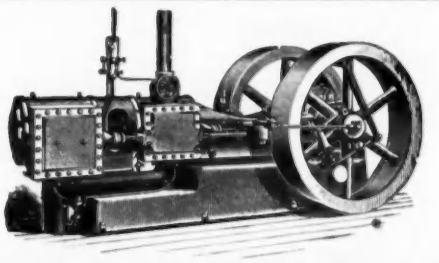

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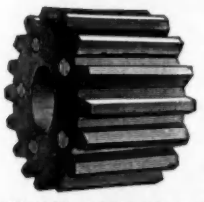

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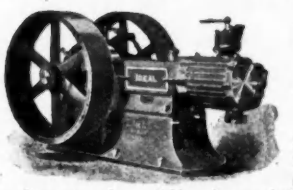

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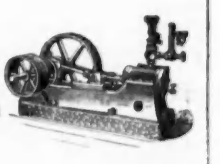

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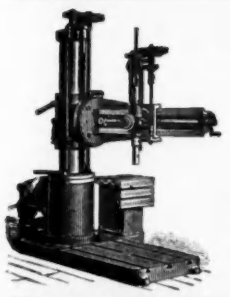

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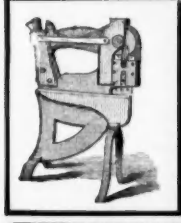

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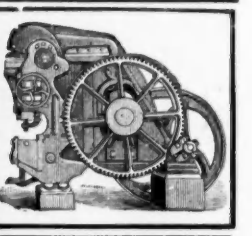

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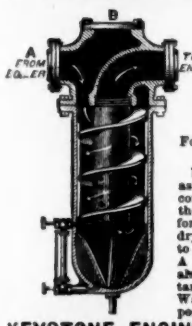

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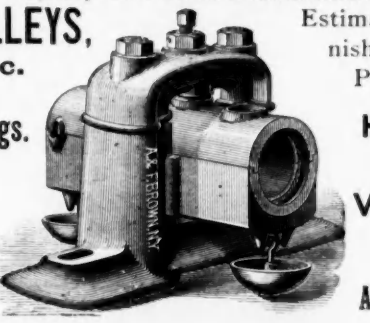

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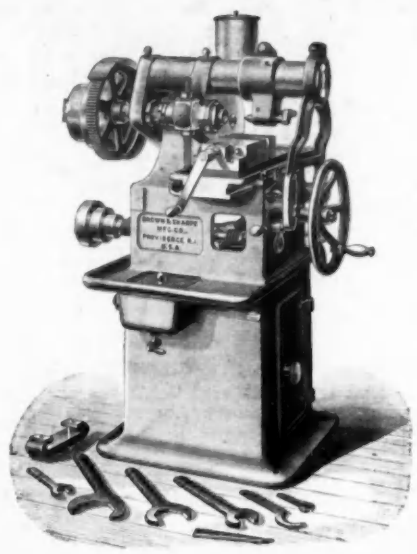

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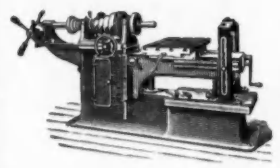

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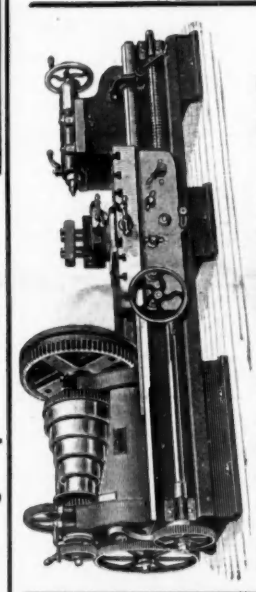

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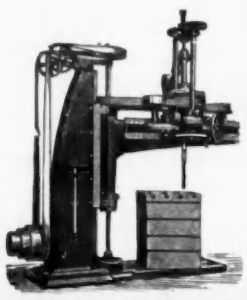

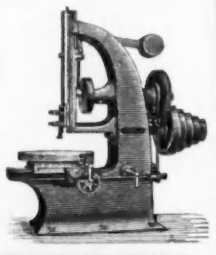

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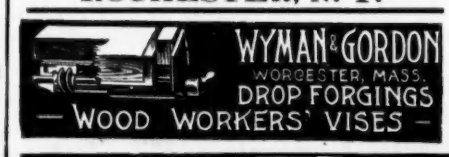

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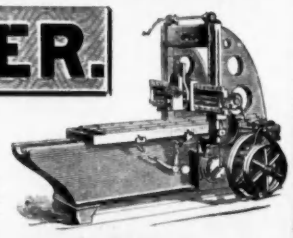

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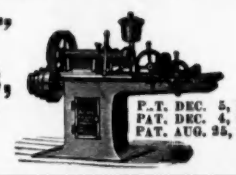

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